ANALYSIS AND DEVELOPMENT OF

POST SECONDARY CURRICULUM ON SUSTAINABILITY

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This thesis examines existing curricula at colleges and universities about sustainability and uses results to develop an introductory post secondary course curriculum. The proposed course is organized around three major elements - - science, philosophy, and economics - - all integral to understanding sustainability. Materials needed to teach the proposed 3-semester hour course including syllabus, teaching modules, transparencies, handouts, and exams were developed. Suggestions on how to teach a one-semester hour course on sustainability and a workshop on sustainability are also presented. The following research and curriculum development was a project established and funded by the Texas Energy Office, Renewable Resources and Sustainability Program.

ACKNOWLEDGMENTS

The research and creation of this curriculum on sustainability for the post secondary level was funded by the Texas Energy Office, Renewable Resources and Sustainability Program.

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INTRODUCTION

A sustainable environment is an environment in which we live our daily lives using materials and resources at the same rate in which we replace them. Called an environment at equilibrium, it is composed of air, land, water, and living beings. Sustainable communities have industry and technologies advanced enough to put back whatever they take out of our environment. In the absolute simplest of terms, when a tree is cut down and used for paper products, another is planted. While that tree grows, one must recycle to maintain the demand until the new tree is ready to be processed. This example is a simplification of a more complex idea, demonstrating the process of replenishing the earth with resources of equal quality for our future generations. A sustainable environment is always looking for the better way to supply all needs. Possibly not cutting down trees at all and finding new alternatives for these demands is one way to establish a sustainable planet.

Sustainability is extremely hard to define. My personal definition of sustainability, derived from reading numerous other definitions, is "the ability to grow spiritually, physically, and technologically while maintaining the essential elements for life for the next generation". The idea of creating a sustainable environment involves so much more than preserving trees. It involves economics, politics, and technology. As stated by the University of Washington (1995), "It is about understanding our situation and developing as communities in ways that are equitable, and that make sense ecologically and economically."

It has been noted by many that we (humankind) are at a point in the history of the planet in which drastic measures need to be taken to preserve the future. A sustainable planet is a goal we must achieve. To reach this goal, steps have already been put into place at different levels. This is where *my* research began.

The Texas Energy Office granted The University of North Texas funds to create and implement curricula on the topic of sustainability. The purpose of my research is to create a post-secondary curriculum for the university that could be shared with other universities.

The scope of my study began by conducting research of other curricula similar in topics and contents to that which I am creating. Using these as models, a course covering a plethora of sustainability themes was established.

The following chapters in this thesis consist of:

-a literature review including the history of sustainability

-methods and procedures used in creation of the curriculum

-a discussion of results (analysis) of research

-the conclusions leading to curriculum development

-several course syllabi

-and lesson plans for an introductory level course on sustainability including all necessary materials.

LITERATURE REVIEW

A literature review was completed to help establish a consistent and acceptable definition of sustainability. A brief history helps explain where we are and how far we have come in its development, and present curricula gives an idea of the overwhelming need for more knowledge in this area.

A. Definitions

Although many maintain that sustainability remains almost impossible to define, but tried by few, here are some interpretations on the controversial topic. Sustainability is:

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs." *The Brundtland Commission 1987*

"leaving a habitable planet for our descendants." *John Cairns Jr., Virginia Polytechnic Institute and State University*

"the maintenance of the potential for our land and water ecosystems to produce the same quantity and quality of goods and services in perpetuity." *Jerry Franklin University of Washington Forestry Professor*

"doing things in a way that, if you keep doing them that way, will continue to work." *Harvy 1996*

"Development which improves people's quality of life, within the carrying capacity of the Earth's life support systems. . . . living on the Earth's income rather than eroding its capital." *British Government White Paper, 'This Common Inheritance', 1990*

Within all of my research, each definition, no matter how simple or complex, has stressed humanity and an equal quality of life for future generations. An equal "quality of life" became a major topic I chose to investigate.

Having an equal "quality" of life means that our future generations will have, at minimum, the same opportunities to live as comfortably as we do today. This does not mean things do not advance because sustainability is not anti-growth nor extreme environmentalism. It does not place natural systems above humankind. Sustainability is for technology and industry as long as the benefits outweigh the costs in keeping our earth's "quality of life" maintained.

Humans depend on the earth and all living things for our existence. " It (sustainability) places a high value on human life but accepts that human culture ultimately owes its existence to nature in its entirety (Jerry Franklin)." In knowing this, how could anyone not support the idea of creating a sustainable environment?

B. History

The history of sustainability is hopefully on the upward swing of what could be called an environmental roller coaster. Beginning with the Aborigines and Native Americans, Mother Earth was a well-respected part of everyday culture. They believed in the mutual obligation between hunter and hunted and they had an immediate and reciprocal relationship with their natural environment. David R. Lewis put it nicely when he stated "Indians were never ecologists—something that refers to a highly abstract and systematic science—but they were careful students of their functional environments, bound by material and cultural needs and constraints, striving for maximum sustained yield, not maximum production. They possessed an elaborate land ethic based on use, reciprocity, and balance (Lewis, 1994)." Today's environmentalists have found inspiration in the Native American actions and attitudes. They (Indians) are seen as people who left no mark on the land.

The increased number of Europeans to the Americas began to dramatically affect the environment. The New World was being altered physically and culturally with the disappearance of native flora and fauna, and with changing resource use patterns. This created the downward slope on the environmental roller coaster and it is much easier to go down than up, much like it is easier to degrade the environment than to replenish and restore it (the upward slope).

The more modern history of sustainability is that before the 1900's, there was little concern about maintaining a quality of life for our future generations.

The first person to think about creating a sustainable environment, without using today's terminology "sustainable", was Gifford Pinchot. Pinchot became head of the U.S. Forest Service in 1898 and was named Chief Forester by President Theodore Roosevelt in 1901. Pinchot and Roosevelt defined *conservation* as "the wise use of the Earth's natural resources, so that renewable ones, like timber, could regenerate, and nonrenewable ones, like coal, could be prudently utilized to last as long as possible (Grey Towers, 1999)." This definition of conservation is what is thought of today as the term sustainability. Pinchot's principle "the greatest good of the greatest number in the long run (Grey Towers, 1999)." is what the National Forest Management was guided by. After Pinchot, there were many other *environmentalists*, who helped pave the way for understanding the creation of a sustainable environment.

The 1880's to 1920 was known as the "conservation/preservation period (Schoolmaster, 1999)." Several laws, the Reclamation Act in 1902 and the National Park System in 1912, were established and helped regulate land, air, and water.

The 1920's to1960 was a time where non-government organizations took the lead in many actions. Much literature was being written/published such as *Land Ethic* by Aldo Leopold, which emphasizes the environment's right to a healthy existence. Another source was *Should Trees Have Standing* by Stone asking do trees have rights in court situations. Legislation is continuing in the environmental direction.

The 60's brought *Silent Spring* by Rachel Carson (1962) which opened eyes towards environmental issues. The Multiple Use and Sustained Yield Act of 1960 allows a variety of uses on the same land at the same time while the principle of sustained yield states that a potentially renewable resource should not be harvested or used faster than it is replenished. This was a decade when the term *environmentalist* was not supported by many and the free spirit of wanting to "get back to nature" was seen as giddy. However, the National Environmental Policy Act of 1969, (NEPA), became the national charter for protection of the environment. It establishes policy, sets goals, and provides means for carrying out the policy.

The 70's were a period where more governmental regulation on environmental issues took place. EPA legislation was strong, and Environmental Impact Assessment Policies were implemented. The Clean Air Act, The Clean Water Act, The Endangered Species Act, and The Resource Conservation and Recovery Act are just a few of the important policies of this decade.

The 80's brought about increased use of free markets and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA is also known as Superfund and it created a tax on the chemical and petroleum industries and provided Federal authority to respond directly to the release of hazardous substances that may endanger public health or the environment.

Finally, the 1990's and beyond is considered the "period of renewed interest in the environment (Schoolmaster 1999)." More and more, people came to realize that our environment needs help, and we are the only ones with power to do so. Creating a sustainable environment requires the knowledge of our past, the understanding of our present, and the desire of our future.

Many individuals, communities, and businesses are making moves towards becoming more sustainable. There are even organizations dedicated strictly to sustainability education. For example The Natural Step is an organization that promotes sustainability by using four basic principles to educate the public on ways to improve our current existence. Another group making a change is the Nike Corporation. Using sustainable business practices by following The Natural Step's principles is their way of doing their part.

C. Current Curricula

The majority of curricula regarding sustainability I found were on the web site for Second Nature. This is a non-profit organization promoting education for sustainability. Currently 546 syllabi of courses being taught across the United States with content themes dealing with sustainability are posted on the site. One of the goals of this organization calls for "a long term societal effort to make environmental and sustainability concerns a central theme in all education (secondnature.org 1999)". The number of universities involved with this movement exemplifies the necessity of such knowledge. A more in-depth discussion of particular curricula will be mentioned in the following chapters.

An establishment of the critical need to move towards a more sustainable environment is obvious through the literature review. The development of a post-secondary curriculum is an ideal way to help in this movement. Providing the knowledge needed to make more informed decisions in everyday life is putting one more foot forward towards reaching our goal of a sustainable planet.

METHODS AND PROCEDURES

Research for sustainability curricula began in January 1999. It included an internet investigation along with e-mail contacts, travel to a sustainability workshop in Portland, Oregon, corroborating with Bridges To Sustainability (a non-profit organization dedicated to sustainability, out of Houston Texas) and an exploratory workshop given at the University of North Texas in November of 1999. In this chapter, a detailed description of all of the above listed tasks is discussed.

A. Internet Research

Key words were used to find leads to sustainability web sites. Words such as: sustainability, curriculum, recycle, post-secondary, environmental education, and the like lead to a plethora of information. The numerous definitions of sustainability were found along with a web site created by Second Nature. Within this site there are currently 546 syllabi of courses taught around the United States relating to sustainability, with the number (of syllabi) increasing every day. This is where my detailed investigation began.

In looking at the hundreds of syllabi already in existence, I realized there was not one course with an all-encompassing theme of sustainability. Subject areas in which courses are being taught range from agriculture to history to urban and community planning with everything in between. A systematic way of evaluating these courses in their sustainability content definitely needed to be established. Therefore, I developed an evaluation tool with content themes that *should* be discussed within a sustainability unit. This evaluation tool was modeled

after a similar tool used by Second Nature for professors to critique their own subject matter (2nature, 1999). Along with this evaluation tool is a "Theme Explanation" sheet to better explain what is meant by each parameter. In light of this tool, quality (high sustainability content) courses were recognized to help aide in the creation of the sustainability course I developed. The evaluation tool titled Sustainability Course Content Themes and the Theme Explanation sheets are as follows.

In this course, there is . . .	Key words/terms to look for within each prameter.	Choose a number between 0 and 5. Not at all = 0 Continuously = 5
1. an emphasis on both human and natural systems.	ecosystem, biodiversity, humans	
2. an emphasis on the global effects of human activities.	global outcomes	
3. an explanation that humans are part of nature and an exploration of ways we can live in harmony with it.	coexist	
4. an emphasis that the effects of many activities extend in time beyond current generation of humans.	sustainable, generations	
5. the teaching that the prime goals of civilization are equity, justice, cultural development, and environmental sustainability.	equity, cultural develpoment, justice	
6. the examination of topics from the perspectives of multiple disciplines.	multidisciplinary, interdisciplinary	
7. much stress put on the fact that individual and community improvement is the central goal of development.	improvement	
8. an emphasis that human endeavors must operate within the capabilities of the functions of the natural system.	carrying capacity	
9. the promotion of the concept of a qualitative change as a measure of success (development), rather than a quantitative change as a measure of success (growth).	growth, development	
10. stress on the statement, sustainability is "meeting the needs of the present without compromising the ability of future generations to meet their own needs."	meeting needs of future	
11. an emphasis on environmental citizenship.	morals, ethics, values	
University/college:	Course Name:	

SUSTAINABILITY COURSE CONTENT THEMES

THEME EXPLANATIONS

1) an emphasis on both human and natural systems.

In this parameter the word biodiversity is looked for. Biodiversity of an ecosystem would imply that it has a variety of living "things" including humans, animals, plants, and organisms. In evaluating this parameter the ranking (1-5) is based on how often the topics are mentioned in the syllabus.

2) an emphasis on the global effects of human activities.

Having global effects requires the discussion of "global issues". Climate change would be an excellent topic to discuss in this situation. Stress needs to be put on the fact that we live in a so-called "bubble". Whatever our actions are today will affect our air and waters today and tomorrow. These are cycles that will eventually come back around and have an impact somewhere in the world.

3) an explanation that humans are part of nature and an exploration of ways we can live in harmony with it.

Coexistence is the term that would best describe humans living in harmony with nature. For an exploration in ways to accomplish this, one needs to discuss recycling, conservation, and other environmentally friendly ideas. A clear picture must be set that any type of degradation to the environment is not living in harmony with it.

4) an emphasis that the effects of many activities extend in time beyond current generations of humans.

What we do today affects our children's children. The fossil fuel consumption, destruction of forest, and polluting of our planet are not things that will go away or be replenished in our lifetime. To fulfill this parameter one must bring up the term sustainable in the context of resources and land uses.

5) the teaching that the prime goals of civilization are equity, justice, cultural development, and environmental sustainability.

In teaching these goals one must stress environmental sustainability. If this goal is achieved equity, justice, and cultural development will be much easier to accomplish as well. In a course that stresses this parameter, government structure and human/cultural values need to be touched on.

6) the examination of topics from the perspectives of multiple disciplines.

Diverse topics such as ethics, government, economics, agriculture, architecture, religion, etc. must be discussed within each course. A minimum of four different disciplines integrated into a course must be obtained to be considered multidisciplinary.

7) much stress put on the fact that individual and community improvement is the central goal of development.

Improvement is to make better. Development is to make better. Therefore, to accomplish this parameter the course must be focused on the community. If the community is "made better" then the individuals within the community will be made better. Or vice versa, if each individual is "made better" then the community will be better because of it. So key words need to be self-improvement, community improvement, and sustainable development.

8) an emphasis that human endeavors must operate within the capabilities of the functions of natural systems.

All natural systems have a carrying capacity. If all aspects of this carrying capacity are not met, then environmental degradation occurs. Key topics to accomplish this parameter are degradation, sustainable ecosystems, and coexistence.

9) the promotion of the concept of a qualitative change as a measure of success (development), rather than a quantitative change as a measure of success (growth).

To discuss the differences between qualitative vs. quantitative an instructor must define "quality of life". Is a better quality of life achieved by having <u>more</u> (quantitative) or by increasing the degree of excellence at which a person lives (qualitative)?

10) stress on the statement, sustainability is "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

In complying with this parameter the course must have this definition or another similar definition of sustainability. The professor must discuss interactions between humans and nature to make it clear that our world and its resources are precious and limited.

11) emphasis on environmental citizenship.

A discussion of environmental citizenship includes ethics, values, and morals. Being a good environmental citizen means having an environmentally friendly way of life.

B. Natural Step Workshop: Portland, Oregon

April 14-18, 1999 I, accompanied by Dr. Thomas La Point, attended an annual workshop put on by The Natural Step in Portland, Oregon. The workshop consisted of general sessions full of well-known speakers for sustainability, breakout groups with very specific agendas regarding sustainability, and field trips to places (mostly businesses) that have changed their outlook and production of goods and services to be more sustainable.

Through listening to the speakers, I realized that The Natural Step is a great framework to follow for anyone or any group trying to become more sustainable. It especially is an appropriate guide to follow in helping to design a sustainability curriculum.

The most important aspect of attending the workshop was all of the contacts I made. In a breakout session on Post-Secondary Education, I met Tony Cortese who then introduced me to Beth Beloff who works for Bridges to Sustainability in Houston, Texas. Mrs. Beloff is also working on curriculum in conjunction with Rice University.

Another face I was able to match with the voice in which I had made many contacts through e-mail and by telephone was with Mr. George Bandy, II. Mr. Bandy is the Sustainable Development Officer in Support Services for The University of Texas Health Science Center in Houston, Texas. He has been a source I have relied on for inspiration and knowledge.

As far as the speakers go, I had the pleasure of listening to and meeting Mathis Wackernagel who came up with and wrote *Our Ecological Footprint* (1996). He reassured that teaching this concept is an integral part of completely understanding the meaning of sustainable environment.

C. Bridges To Sustainability: Houston, Texas

Upon returning from Portland, I had spoken with Mrs. Beth Beloff on several accounts. We arranged to get together and exchange ideas, leads, and materials. I flew to Houston June 21, 1999, and had a workday full of interesting and informative information. Mrs. Beloff lent me literature and offered her further assistance as needed.

D. Sustainability Workshop: The University of North Texas

Saturday November 20, 1999, I held a special workshop on sustainability for environmental science students, environmental ethics students (both graduate and undergraduate), faculty, and anyone else interested in the topic. The workshop was from 9:00 a.m. to 12:00 p.m. with a detailed agenda discussing the three modules in which a course on sustainability would or should be taught. Written materials were provided, visuals and hands on activities were all a part of the presented agenda. A pre and post-test were given to evaluate the effectiveness of information presented, and an evaluation of the entire workshop was filled out by all participants.

DISCUSSION/ANALYSIS OF RESULTS

In this chapter, specific modules are discussed along with the statistics that lead to the conclusions for the modules being used. Outcomes from the Natural Step workshop and from visiting Bridges to Sustainability in Houston were considered, and the benefits will be explained. Lastly, contributions from the sustainability workshop presented at North Texas will help sum the approaches taken in creating this curriculum.

A. Internet Research

Of all sustainability definitions found on the Internet, not one alone could be used to give a thorough explanation of the concept. Therefore, all definitions are presented in the literature review and will be presented within the curriculum created to bring in all aspects involved in the idea of sustainability.

As far as finding curriculum on sustainability, numerous amounts were found for K-12 teachers, but the most informative for post-secondary curriculum was found on The Second Nature web-site. The 546 syllabi needed evaluating for their sustainability content, so the "Course Content Themes" evaluation tool was used. Syllabi within each subject area were evaluated and an average weighted score was given for each. As mentioned on the evaluation sheet a score (ranking) of 5 means that it was full of sustainability content while a ranking of 0 means that there was no discussion of sustainability within the course. Refer to Figure1 for the results.

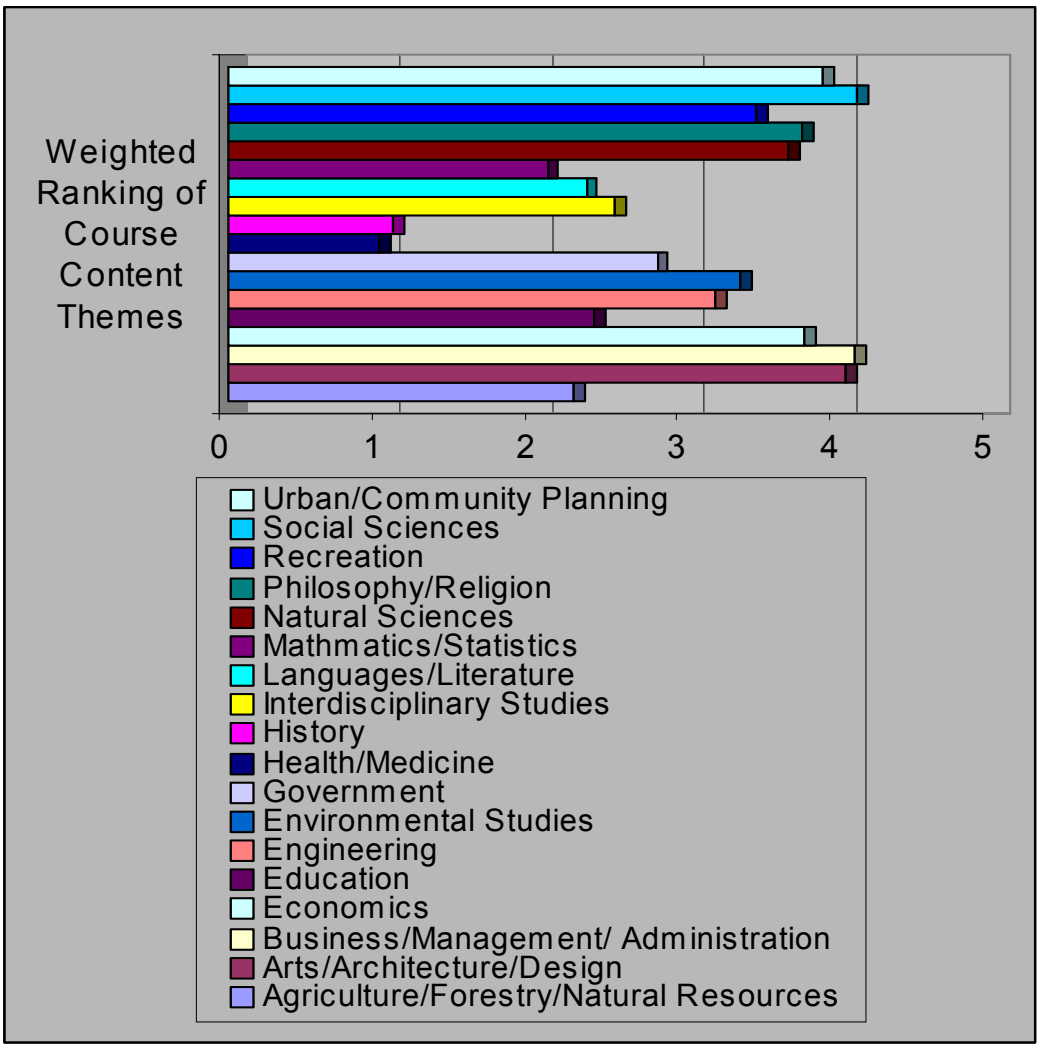


Figure 1: Weighted Ranking of Subjects Using the Course Content Themes

After "ranking" many of these courses, they were compared to The Second Nature's Course Subject Areas and Teaching Levels (Table 1).

SUBJECT	NUMBER OF SYLLABI	Graduate	Undergrad	Mixed	not specified
Agricluture/Forestry/Natural Resource	33	1	14	1	17
Arts/Architecture/Design	15	8	5	0	2
Business/Management/Administration	58	23	7	9	19
Economics	35	3	21	0	11
Education	37	11	12	5	9
Engineering	12	4	6	0	2
Environmental Studies	42	6	32	0	4
Government	48	17	15	3	13
Health/Medicine	28	15	5	1	7
History	23	2	14	1	6
Interdisciplinary Studies	18	3	12	2	1
Languages/Literature	6	0	3	1	2
Mathematics/Statistics	3	1	1	0	1
Natural Sciences	53	3	29	3	18
Philosophy/Religion	63	13	48	0	2
Recreation	4	0	3	0	1
Social Sciences	56	7	40	1	8
Urban/Community Planning	12	7	3	0	2
TOTAL:	546	124	270	27	125

Table 1: Second Nature's Course Subject Areas and Teaching Levels

I found the courses that ranked high in sustainability content also were found within subject areas with the largest number of syllabi available (Table 2). Note that Business/Management/Administration and Economics courses make up 17.0 % of the syllabi, Environmental Studies and Natural Sciences make up 17.4 %, and Philosophy/Religion and the Social Science courses make up 21.8 % of the syllabi (Figure 2). The high rankings of sustainability content along with the percentages of syllabi within each of these subject areas concluded that the modules that need to be used in a sustainability course are Economic/Business, Science, and Philosophy approaches.

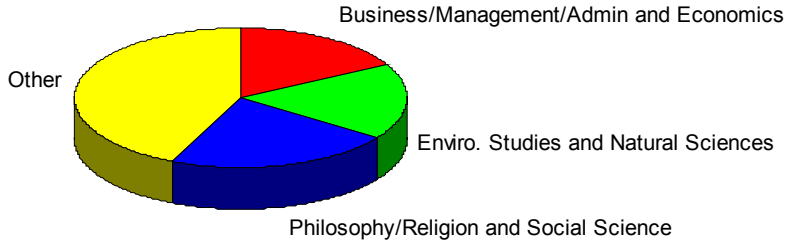


Figure 2: Second Nature Course Syllabi Percentages

SUBJECT	NUMBER OF SYLLABI	Graduate	Undergrad	Mixed	not specified
Agricluture/Forestry/Natural Resource	33	1	14	1	17
Arts/Architecture/Design	15	8	5	0	2
Business/Management/Administration	58	23	7	9	19
Economics	35	3	21	0	11
Education	37	11	12	5	9
Engineering	12	4	6	0	2
Environmental Studies	42	6	32	0	4
Government	48	17	15	3	13
Health/Medicine	28	15	5	1	7
History	23	2	14	1	6
Interdisciplinary Studies	18	3	12	2	1
Languages/Literature	6	0	3	1	2
Mathematics/Statistics	3	1	1	0	1
Natural Sciences	53	3	29	3	18
Philosophy/Religion	63	13	48	0	2
Recreation	4	0	3	0	1
Social Sciences	56	7	40	1	8
Urban/Community Planning	12	7	3	0	2
TOTAL:	546	124	270	27	125

Table 2: Second Nature's Course Subject Areas and Teaching Levels with High Sustainability Content

B. Natural Step Workshop: Portland, Oregon

Several parameters of my sustainability curriculum came from lectures, ideas, and discussions that took place at the Natural Step workshop. Their Four Principles to Maintain a Sustainable Planet (Secondnature.org, 1999), have become a center point of the curriculum design. The four points are: 1) Reduce what we take from the earth's crust. 2) Reduce what we make from all materials; natural and synthetic. 3) Maintain and improve the current quality of the natural environment. And 4) Distribute resources fairly. These four principles follow along with the three modules (economics, science, and philosophy) I have chosen to develop the curriculum. What we take, make, and maintain all deal with science and economics, and equity deals with the philosophy component. In short, these principles reinforce the concepts that will be taught.

As a major component of this curriculum, the ecological footprint will be a concept brought up in all subject areas: science, economics and philosophy. *Our Ecological Footprint* by Mathis Wackernagel and William Rees will be required reading and discussed in great detail. Listening to M. Wackernagel at the Natural Step workshop helped me to realize the importance of our footprint and the desperate need for everyone to understand how human activities impact the planet.

C. Bridges To Sustainability: Houston, Texas

The curriculum outline that Mrs Beloff was creating with a professor at Rice University, was not exactly what I was looking for. Beloff and I agreed that the science, philosophy, and economics of sustainability all need to be brought out within the curriculum, but her approaches conflicted with my ideas on how it should be done. Her idea is to create ways to bring in sustainability aspects to an already existing course. Although in compliance with my grant, I am creating an entirely new course dedicated to teaching students all components involved with sustainability, beginning with the history and ending with real commitments each student can make to become more sustainable. My course will stress the importance of the individual.

D. Sustainability Workshop: The University of North Texas

Turnout for the workshop was a little disappointing at first, but, overall, it was a positive experience, and I feel I gained more insight towards creating a course. There were a six people present during the day. After reflection, I realized it might have been a good thing so few people attended because the discussions were fabulous and thus, the most beneficial part of the workshop.

The day began with a pre-test to gauge where each participant stood in their knowledge of sustainability (Appendix A). This test was modeled after several different tests, one being the well known CHEAKS test (Children's Environmental Attitudes and Knowledge Survey) from Memphis, another from Escape From Affluenza (pbs.org, 1999), and lastly from the Academic Pentathlon

in Texas. My goal was to raise everyone's post-test score (Appendix B) from information gained during the workshop. (Answers for both tests can be found in Appendix C.) I realize that my sample group was biased, in that they would not have been there had not they had an interest in the topic, but even with the high pre-test scores, all post-test scores improved. Each test consisted of 30 questions. On the pre-test, the average number of correct answers was 18.25 and on the post-test the average number of correct answers was 24.75. This calculates to an average increase in knowledge of 21.7%.

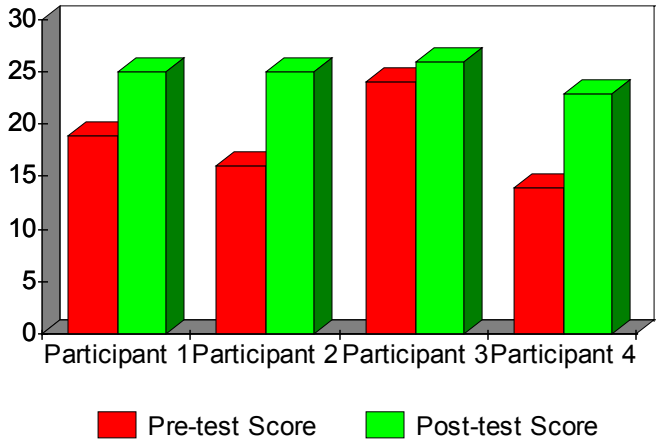


Figure 3: Participant Test Scores

As mentioned previously, the discussions were probably the most beneficial. Everyone seemed to agree that the three disciplines (science, philosophy, and economics) were all encompassing. We discussed how even

"sub-topics" could be placed under each discipline. Some of the topics were as follows:

PHILOSOPHY	SCIENCE	ECONOMICS
Ethics	Environmental	Business
Morals	Life	Accounting
Religion	Earth	Statistics
Culture	Chemistry	

Workshop participants reinforced what I discovered through my research in that they agreed these three modules were all encompassing, and a course could be created around these areas.

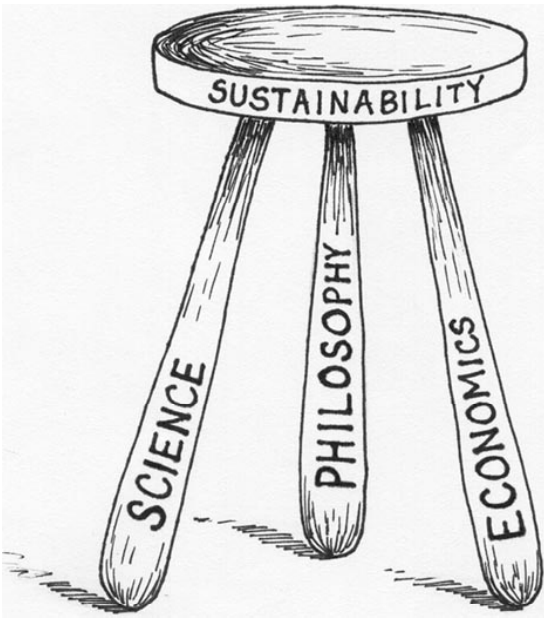


Figure 4: Balancing Sustainability illustrated by Karen McGinnes

CONCLUSIONS

Research confirmed what the Texas Energy Office has already established, that is, there is a desperate need for a curriculum on sustainability at the post-secondary level. Through information gathered, I feel a thorough course could be taught if it encompassed the scientific aspects of sustainability, the economics involved, and the philosophies needed to get there. This is where the three-legged stool becomes a great symbol. To become a sustainable planet, these three disciplines must be taught. If any one were left out the stool would surely fall, just as in real life a sustainable planet would never be reached. It will take complete understanding that everything is interconnected for Earth to become sustainable. It is an effort that must begin with the individual.

The application of this course will introduce many people to a new way of life. I hope that after the summation of the course, people will take a step back and re-evaluate their own personal uses of our natural environment. Through introspection, they will take their newfound knowledge and apply it to their work places, communities, and governments.

SYLLABI

The following attached syllabi are for a semester-long course (3 credit hours), a seminar course (one credit hour), and for a day workshop. Each can easily be modified to work within the time constraints given in any of the courses.

SUSTAINABILITY 101

SYLLABUS

Description of Course:

This course is designed to teach the basic necessities that one should know to become an active member in the development of a sustainable planet. It includes the sciences, economics, and philosophies involved within reaching this goal. One should take from this course an individualized plan to implement, since any global change has to start with the individual.

Required Texts:

Our Ecological Footprint by Mathis Wackernagel and William Rees, New Society Publishers, Canada, 1996.

The Ecology of Commerce by Paul Hawken, Harper Collins Publishers, New York, 1994.

Environmental Ethics by Holmes Rolston, III, Temple University Press, Philadelphia, 1988.

Description of Exams:

The course will consist of three Exams. The first two will have thirty multiple choice, fifteen true/false, and five short essays making up the total of fifty questions. The third Exam will consist of fifty multiple choice questions from the last third of the course and fifty multiple choice questions from the entire semester making up the total of one hundred questions.

Description of Projects:

The course requires two projects throughout the semester. The first is a circuit board involving the energy sources. This can be as simple as a file folder or as complex and creative as you can make it. More details will be given the day it is assigned.

The second project is a video you write, produce, and direct, of yourself and how you plan to Escape from Affluenza. This will make more sense as the semester evolves and more details will be given the day it is assigned.

Writing Assignments:

There will be two writing assignments assigned during the semester. The first one is a simple research/opinion paper and the second is strictly an opinion paper. Both papers must be supported with reasons.

Grading Scale:

Writing Assignment 1 – 10%

Writing Assignment 2 – 10%

Exam 1 – 15%

Exam 2 – 15%

Circuit Board – 15%

Video Project – 15%

Exam 3 / Final – 20%

100 %

Weekly Outline:

Week 1 - Values Pre-test

Definitions of Sustainability

History of Sustainability

Reading Assignment: Chapters 1&2 of *Our Ecological Footprint*

Week 2 – Cycles in the Environment

Writing/Research Assignment: Paper on your encapsulated city.

Refer to page 29 in *Our Ecological Footprint*.

Reading Assignment: Chapter 3 of *Our Ecological Footprint*

Week 3 – Renewable and Nonrenewable Resources/Risk Assessment

Project: Begin working on Circuit Board (due Week 6)

Reading Assignment: Finish *Our Ecological Footprint*

Week 4 – Population Dynamics

Writing Assignment: Short Essay- Do you feel that there should be a national or even world population policy? Why or Why not? What steps would you support?

Project: Continue working on Circuit Board

Week 5 – Carrying Capacity

Project: Finish Circuit Board (due next week)

Study: Prepare for First Exam

Reading Assignment: Chapters 1-3 of *The Ecology of Commerce*

Week 6 – Project Presentations & Exam 1

Week 7 – Land Use

Reading Assignment: Chapters 4-7 of *The Ecology of Commerce*

Week 8 – Consumption/Footprint

Reading Assignment: Chapters 8-10 of *The Ecology of Commerce*

Recording: Track your "consumptions" for the week. Write down everything.

Week 9 – Escape from Affluenza

Reading Assignment: Finish *The Ecology of Commerce*

Project: Video, create you own Escape from Affluenza

Study: Prepare for Exam 2

Week 10 – Video Presentations & Exam 2

Week 11 – Quality of Life

Project: Continue working of Video

Reading Assignment: Chapters 1-3 of *Environmental Ethics*

Week 12 – Ethics Verses Values

Project: Continue working on Video (due week 14)

Reading Assignment: Chapters 5-8 of *Environmental Ethics*

Week 13 – Rights

Project: Videos due next week

Reading Assignment: Finish *Environmental Ethics*

Week 14 – Where to go from Here

Study: Prepare for Exam 3 / Final

Week 15 – Exam 3 / Final

SUSTAINABILITY SEMINAR COURSE

SYLLABUS

Description of Course:

This is a lecture course, one hour a week, that is designed to teach the basic necessities that one should know to become an active member in the development of a sustainable planet. It includes the sciences, economics, and philosophies involved within reaching this goal. One should take from this course an idea of how to make a change within one's community.

Recommended Readings:

Our Ecological Footprint by Mathis Wackernagel and William Rees, New Society Publishers, Canada, 1996.

The Ecology of Commerce by Paul Hawken, Harper Collins Publishers, New York, 1994.

Environmental Ethics by Holmes Rolston, III, Temple University Press, Philadelphia, 1988.

Grading System:

This course is pass/fail. It is required to attend a minimum of 80%, of the lectures and be an active participant in class discussions.

Weekly Outline:

Week 1 – What is Sustainability?

The History of Sustainability

Week 2 – Cycles in the Environment

Week 3 – Renewable Resources

Week 4 – Nonrenewable Resources/Risk Assessment

Week 5 – Population Dynamics

Week 6 – Carrying Capacity

Week 7 – Land Use

Week 8 – Consumption

Week 9 – Footprint

Week 10- Affluenza

Week 11- Escape from Afflueza

Week 12-Quality of Life

Week 13- Ethics vs. Values

Week 14- Rights

Week 15- Where to go from Here?

SUSTAINABILITY WORKSHOP

AGENDA

9:00-9:15	Introduction
	Why Sustainability . . . why NOT?
9:15-9:35	Pre-Test
9:35-9:45	Break
9:45-9:55	History
9:55-10:10	Science
10:10-10:30	Economics
10:30-10:45	Break
10:45-11:05	Philosophy
11:05-11:35	Discussion
	Where to go from here?
11:35-12:00	Post-Test

CURRICULUM

The curriculum attached is in-depth lesson plans for a three-credit hour, semester-long course. It is set up for a class that meets once a week for three hours, although it could easily be broken up for one hour or one and half-hour meetings. The syllabi for a seminar course and/or a workshop can be taken and used to pull materials from the in-depth curriculum provided as needed under the circumstances in which these types of courses would be taught.

There are many Figures that can be used as transparencies provided with the curriculum. Each Figure is consecutively numbered as F-1, F-2, etc. and can be pulled from the text or from the Zip disk to be enlarged. A binder including all transparencies and added "Thoughts for the Day" can be found in the Environmental Science Office in the Environment Science and Technology Building. The Thought or Thoughts for the Day (Amazing Eco-Fact and Figures) are provided as a warm-up for each class meeting. It is assumed that the instructor will place these on the overhead before class starts and leave it until instruction begins. These are meant to intrigue the students and provide their mind set for the class session.

Week One

CLASS BUSINESS/HISTORY OF SUSTAINABILITY

Thought for the Day (Amazing Eco-Facts and Figures):

Every year, Americans throw away enough writing paper to build a wall six feet high from Los Angles to New York City and back.

Purpose:

-To inform students of the class and its requirements.

-To define sustainability and explain the brief history of its evolution.

Objectives:

1) To explain the class expectations.
2) To give numerous definitions of sustainability and explain meanings.
3) To give reasons why sustainability is an important issue.
4) To travel through the evolution of sustainability with a brief history.

Background Information:

Read through the transparencies provided of the definitions of sustainability and the history. These are also given within the introduction of this thesis. Also, it may be of help to read the analysis of this report to better understand the reasoning behind the approach taken.

Materials:

Syllabi (one for each student)

Values Pre-test (one for each student)

Transparencies:

Thought for the Day

Syllabus (this will vary depending on the type of course being taught)

Definitions of Sustainability (F-5)

History of Sustainability (F-6 & F-7)

Why Sustainability . . . ? (F-8)

Lets do the Right Thing (F-9)

Sustainability: Philosophy, Economics, Science (F-10)

Procedure:

1) Discuss/Go through the Syllabus together (use the transparency of the ***Syllabus***).

   -Show what each text looks like and where they can be purchased.

   -Discuss the two projects; the circuit board, and the video.

   -Discuss the grading system and format of Exams.

   -Have students highlight important dates (exams, projects due, etc.)

2) Pass out the Values Pre-test. Allow time for every student to complete and turn in before moving on. Keep these to compare each student's score with the score of their Post-test at the end of the semester.

Name _____ Instructor _____ Section _____

SUSTAINABILITY: VALUES PRE-TEST

Answer the following questions based on your first reaction after reading the statement.

1 = strongly agree 2 = agree 3 = neutral 4 = disagree 5 = strongly disagree

1) I worry about environmental problems.

1 2 3 4 5

2) It makes me happy to see people trying to save energy.

1 2 3 4 5

3) I am frightened about the effects of pollution on my family.

1 2 3 4 5

4) I get upset when I think of the things people throw away that could be recycled.

1 2 3 4 5

5) I would be willing to ride the bus to more places in order to reduce air pollution.

1 2 3 4 5

6) It makes me sad to see houses being built where animals used to live.

1 2 3 4 5

7) I Have asked others what I can do to reduce pollution.

1 2 3 4 5

8) I would be willing to write letters asking people to reduce pollution.

1 2 3 4 5

9) I would be willing to save energy by using less air conditioning.

1 2 3 4 5

10) I feel the population growth rate is a problem.

1 2 3 4 5

11) I would give $15 of my own money to help protect an animal.

1 2 3 4 5

12) I buy recycled products whenever possible.

1 2 3 4 5

13) I would be willing to pay more for recycled products.

1 2 3 4 5

14) I turn off lights when they are not in use.

1 2 3 4 5

15) I have talked friends into recycling.

1 2 3 4 5

16) I would be willing to stop buying products to protect the environment.

1 2 3 4 5

17) I would be willing to go from house to house to ask people to recycle.

1 2 3 4 5

18) I enjoy reading stories about the environment.

1 2 3 4 5

19) I am concerned about the population growth rate in other countries.

1 2 3 4 5

20) I feel that I live in total alignment with my values and beliefs.

1 2 3 4 5

SUSTAINABILITY

EVALUATION OF VALUES

ADD UP THE TOTAL SCORE FOR ANSWERS 1-20

81-100: You are a person with little concern of what is going on in your environment. You are unaware that there is even a problem. You most likely do what is convenient and has the least strain on your pocketbook.

61-80: You have some idea that there might be a problem for our future, but you most likely will not take a stand towards change. You probably feel that “one” person cannot make a difference, so why try.

41-60: You have a nice feel for what is going on around you. You are aware of the need for everyone’s support, but you are probably a closet environmentalist. You do your part and “wish” others would do theirs.

20-40: You are a true environmentalist. You believe it is your duty to make a change for our future. You set an example and are not afraid to speak up for what you feel is right environmentally

3) Present the definitions of sustainability (use the transparency ***Definitions of Sustainability*** F-5). Discuss.

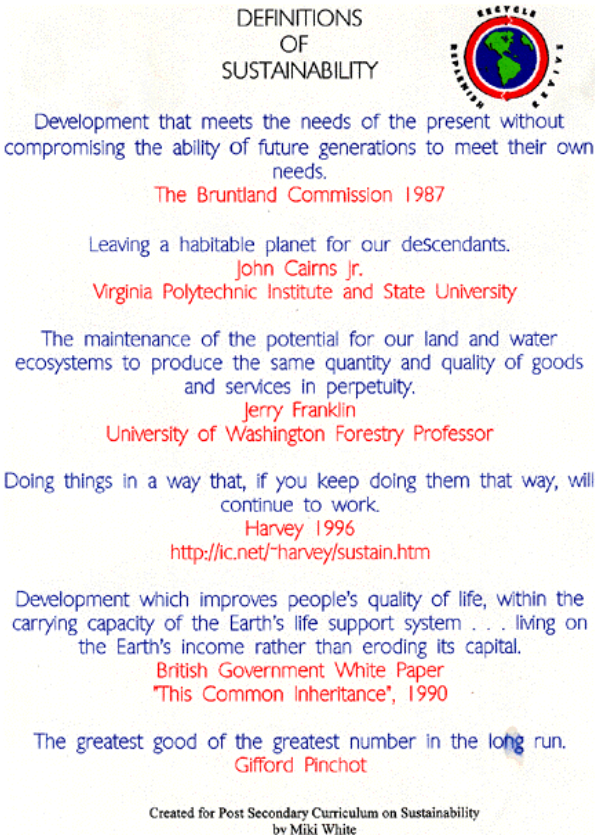
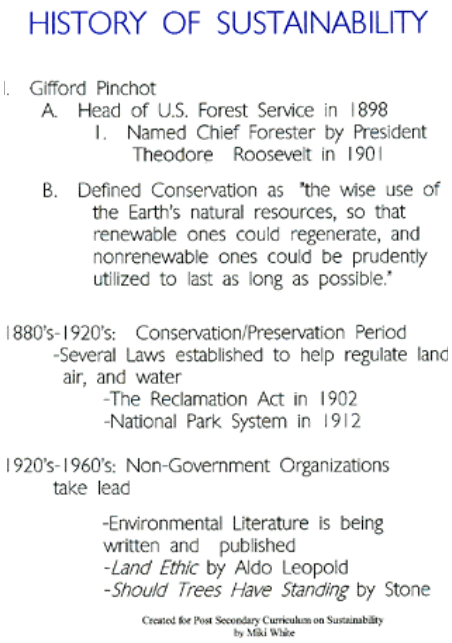


Figure 5: Definitions of Sustainability

4) Discuss the history of sustainability (use the transparency ***History of Sustainability*** F-6 & F-7).



Figures F-6 and F-7: History of Sustainability

5) Place the transparency ***Why Sustainability . . . ?*** , F-8 on the overhead. Read aloud. Place the transparency ***Let's do the Right Thing*** F-9 on the overhead and read aloud. Discuss.

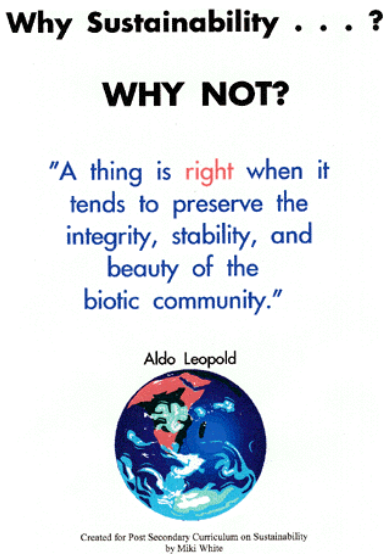


Figure 8: Why Sustainability

Figure 9: Let's do the Right Thing

-Why should we bother with the right thing?

-If the right thing is not convenient, is it O.K. to take the "easy way out"?

-What are some factors that would make someone take the "easy way out"?

-What are the basic things that influence our everyday decisions?

6) Place on the overhead the transparency ***Sustainability: Philosophy, Economics, Science*** F-10 and relate the "things" listed in the above question to each of these categories. For example: Something that might influence our decision to purchase a sustainable product is cost (price). This would fall under Economics. Explain to the students that to become a sustainable planet, we must take all things into consideration, philosophy, science, and economics.

Figure 10: Sustainability: Philosophy, Economics, Science

Assignment:

Reading: Chapters 1-2 of *Our Ecological Footprint*

Week Two:

CYCLES IN THE ENVIRONMENT

Thought for the Day (Amazing Eco-Facts and Figures):

Although 3/4 of the earth is covered by water, less than 1 percent is readily available for humans to use.

Purpose:

To explain how everything, biotic and abiotic, is connected in some way.

Objectives:

1) To describe rhythms of life (cycles in time) and how they effect the environment including:

-Daily rhythms
-Lunar rhythms
-Annual rhythms

2) To describe cycles in matter and how they relate the biotic to the abiotic factors in the ecosystem including:

-The Water cycle
-The Oxygen and Carbon cycle
-The Nitrogen cycle

Background Information:

1) Cycles in Time Vocabulary:

biological clock- an inherent timing mechanism in living systems

diurnal- active during the daylight hours

nocturnal- active during the night hours

tide- the alternate rising and falling of the surface of the ocean

Spring tides- daily tide cycle with the greatest difference between high tides and low tides

Neap tides- daily tide cycle with the smallest difference between high tides and low tides

hibernation- winter resting state

estivation- summer resting state

migrations- to pass from one climate to another for feeding or breeding

Daily rhythms occur with the rise and fall of the sun. Many living organisms have rhythms, both internal and external that follow with this pattern. For example, in humans daily changes in blood pressure, body temperatures, and other biological functions have been recorded to fluctuate depending on the time of day. These daily rhythms have been tested by volunteers living in a sunless environment and the results still show these patterns to exist. Explanation of this occurrence is that humans have a ***biological clock*** that keeps them in the rhythm.

Other daily rhythms are seen in the activity levels of creatures. Different critters are active at different times; those active during the day, ***diurnal***, verses those active at night, ***nocturnal***. Nature has even evolved these creatures differently in that nocturnal animals have more sensitive senses such as touch, taste, and smell as opposed to site. These strengths help nocturnal animals to survive.

Lunar rhythms bring about similar patterns in animals, although these rhythms mostly affect creatures living in or near the oceans. The tides are created by the cycle or positions of the moon in relation to the earth and sun. There are two different cycles within lunar rhythms. They are the daily rise and fall of the tides and the two-week cycle of ***Spring*** and ***Neap tides***. Feeding and breeding schedules of many creatures follow close if not exactly with the rise and fall of the tides.

Annual rhythms are related to the seasons of the year and they affect both plants and animals. Temperatures, light, food supply, and other factors cause animals to go into ***hibernation***, ***estivation***, or even cause them to ***migrate***. Many animals even have a breeding schedule dependent on annual rhythms. Plants have periods within their growing cycle as well. They can be active or dormant depending on their surroundings, which are dependent on the seasons.

Cycles in time, which are abiotic factors, affect all biotic members of the ecosystem. Daily, lunar, and annual rhythms are a large part of the structure of living things. It is important to understand these rhythms because it helps to explain patterns we see in the biotic communities.

2) Cycles in Matter Vocabulary:

condensation- water vapor turns into a liquid due to temperatures cooling

precipitation- any form of water falling to the earth (rain, hail, sleet, snow)

evaporation- liquid water changing to a gas due to rising temperatures

photosynthesis- process of chlorophyll containing plants transforming carbon dioxide into simple sugars using energy and a byproduct is oxygen

nitrogen fixation- process of changing atmospheric nitrogen into usable compounds

homeostasis- equilibrium of an organism's internal environment that maintains conditions suitable for life

The water cycle is probably the most simple cycle to understand yet it probably has more cycles within the cycle than any other. All things need water to survive. The water cycle can most simply be described by the ***evaporation*** of water from oceans, ***condensation*** in clouds, and then ***precipitation*** back to earth. This is the cycle on a large scale, but much more is involved within these processes. There are mini cycles taking place within plants and animals. Plants take in water through their roots much like animals take in water through drinking. These organisms use the water as needed throughout their bodies then, they both lose it back to the atmosphere through respiration and excretions. Even after organisms die, they release water through the decomposition of their bodies. Once water is returned to the soil it can then be evaporated to begin the process all over again.

The carbon and oxygen cycle is just as complex as the water cycle due to the many routes it can take. Carbon is found in the environment in the form of CO_2 gas.

Plants take in this gas with water and in the presence of chlorophyll and combine it chemically to make sugar through ***photosynthesis***. Oxygen is released as a by product from this process. Animals take in this oxygen for the process of respiration and release carbon dioxide back into the air. Carbon dioxide can also be released from the decay of dead organisms. Decomposers break down dead organisms, which in turn, releases carbon dioxide. If dead organisms do not decompose, then over thousands of years these bodies are compressed and can change into fossil fuels such as oil, coal, and natural gas. Humans can then burn these fuels for energy, which releases the CO_2 back into the atmosphere starting the cycle over again.

Nitrogen makes up about 78% of the atmosphere and all living organisms need nitrogen to build proteins and other body chemicals. Although there is a lot of nitrogen in the air, organisms cannot use it directly. ***Nitrogen fixation*** has to take place in order for it to become usable by organisms. Usable nitrogen compounds can be created by lightning or by bacteria. Bacteria turns nitrogen into nitrates, which can then be used by plants to create nitrogen compounds. Animals can then eat plants and use their nitrogen compounds to create their own. After organisms die, decomposers break down nitrogen compounds and return them to the soil for the cycle to begin again.

The constant recycling of water, carbon, oxygen, and nitrogen through the ecosystem is vital to its existence. All biotic things are linked to abiotic factors by their need for chemicals to survive. Matter cannot be replenished therefore it must be recycled. This constant recycling is imperative to maintaining ***homeostasis*** in ecosystems. It is

essential to the health of all species. The interactions among all organisms and the physical factors in the environment result in a balance necessary for a sustainable planet.

Materials:

Our Ecological Footprint by Mathis Wackernagel and William Rees

Transparencies:

Thought for the Day

Monthly Tide Cycles (F-11)

The Hydrologic Cycle (F-12)

Photosynthesis (F-13 & F-14)

Carbon Cycle Through Marine and Terrestrial Ecosystems (F-15 & F-16)

Cycles in Nature (nitrogen cycle F-17)

Soil Ecology (F-18)

Cycling of Critical Chemicals and One-way Flow of Energy (F-19)

Procedures:

1) Discuss Cycles in Time; begin by discussing daily rhythms. The rise and fall of the sun causes all things to have some sort of pattern.

   Discussion Question:

   -What type of rhythms have we as humans established due to the rise and fall of the sun?

2) Explain the Lunar Cycle. Use transparency ***Monthly Tide Cycles***, F-11 to help students visualize the pattern.

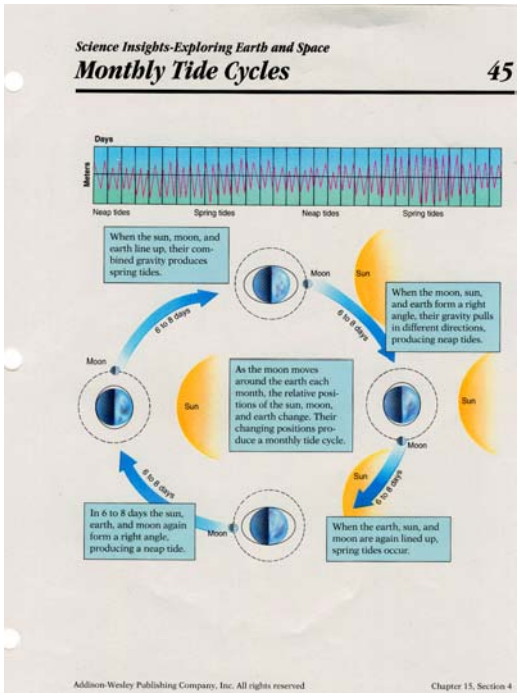


Figure 11: Monthly Tide Cycles

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Discussion Questions:

-How are organisms affected by the lunar cycle?

-What examples of *nocturnal* animals can you give?

-What evolutionary traits have these animals adapted?

3) Talk about Annual rhythms. Some entire life expectancies are based on annual rhythms.

Discussion Questions:

-Explain the life cycle of a common plant.

-What happens if the seasons are not *typical* in weather changes?

4) Discuss Cycles in Matter; begin with the Water Cycle. Use the transparency labeled ***The Hydrologic Cycle***, F-12 for a large scale visualization of the cycle. Show the ***Photosynthesis***, F-13 & F-14 transparencies for a small scale cycle.

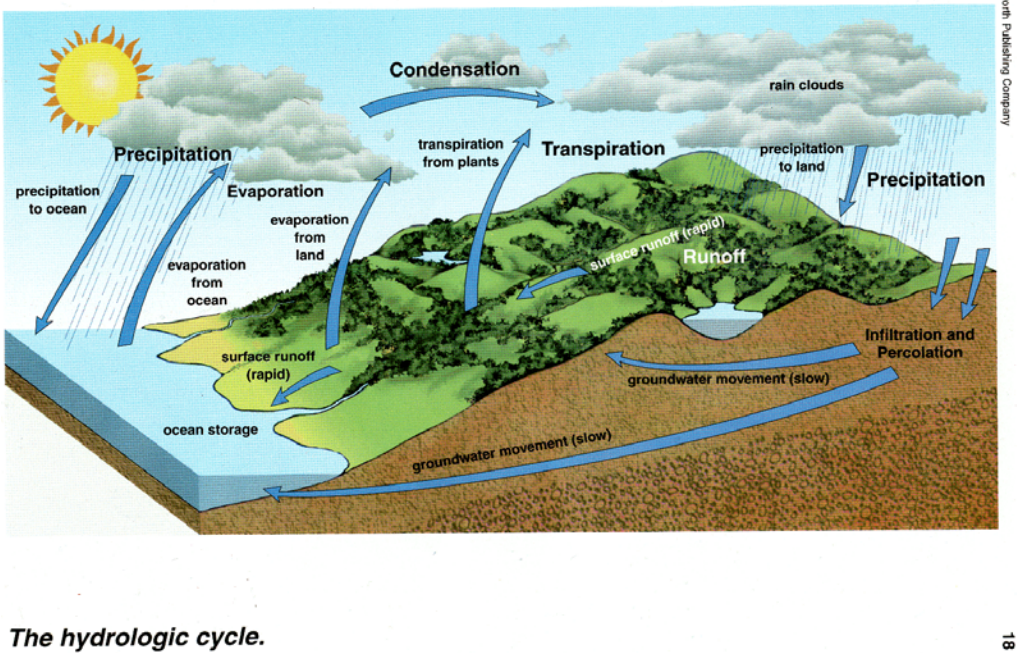

Figure 12: The Hydrologic Cycle

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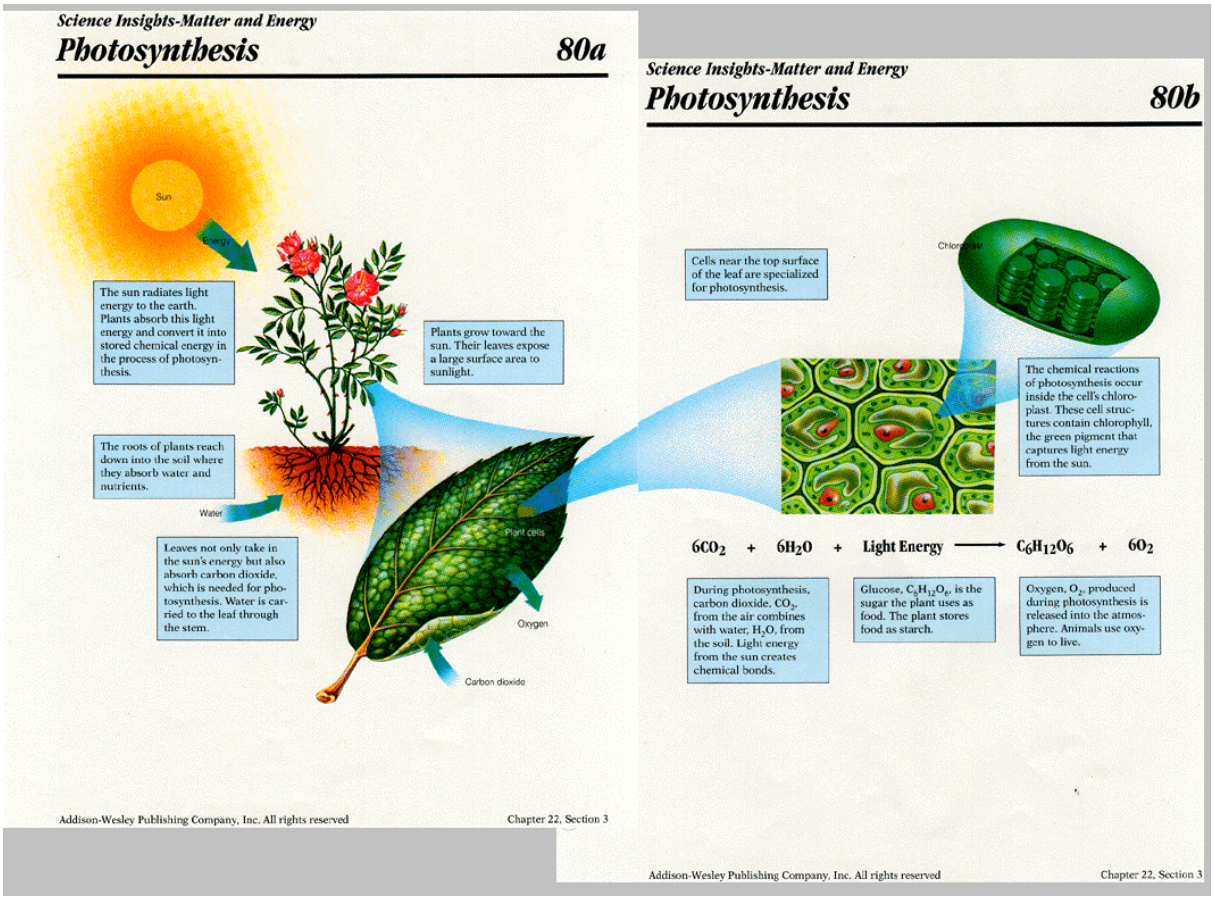

Figure 13 and Figure 14: Photosynthesis

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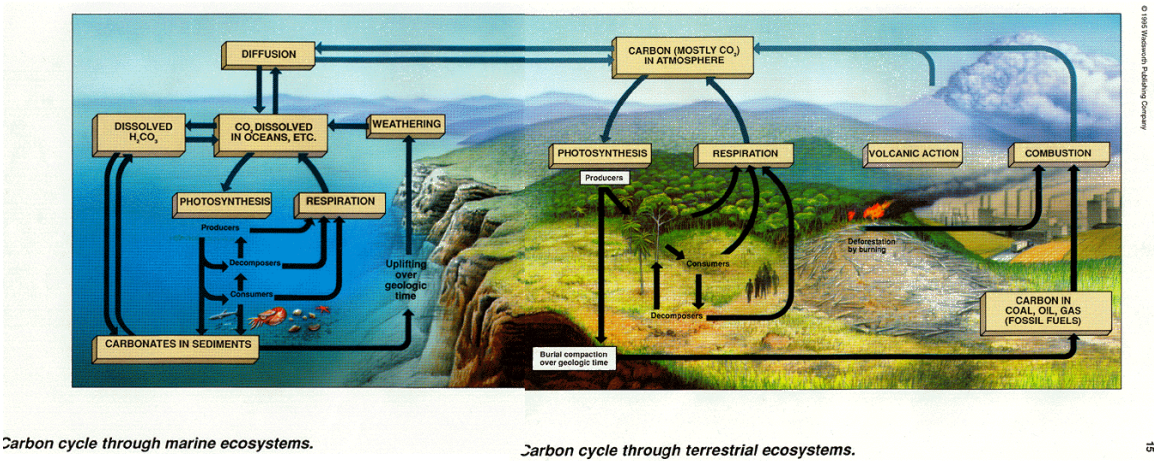
Discussion Questions:

-How do humans play a role in the water cycle?

-Could we "run out" of water?

-What are some causes that may hinder our water supply?

5) Explain the Carbon and Oxygen cycle. Use the ***Carbon Cycle Through Marine and Terrestrial Ecosystems***, F-15 & f-16 transparency for visualization.



Figures 15 and 16: Carbon Cycle Through Marine and Terrestrial Ecosystems From *Environmental Science, 5th edition*, by G. T. Miller, Jr.. © 1995. Reprinted with permission of Brooks/Cole, a division of Thomson Learning. Fax 800 730-2215.

Discussion Questions:

-How is the destruction of the rainforest linked to this cycle?

-If the burning of fossil fuels are a part of this cycle how can we justify alternative energy sources?

6) Talk about the Nitrogen cycle. Use the ***Cycles in Nature*** (nitrogen), F-17 transparency for visualization.

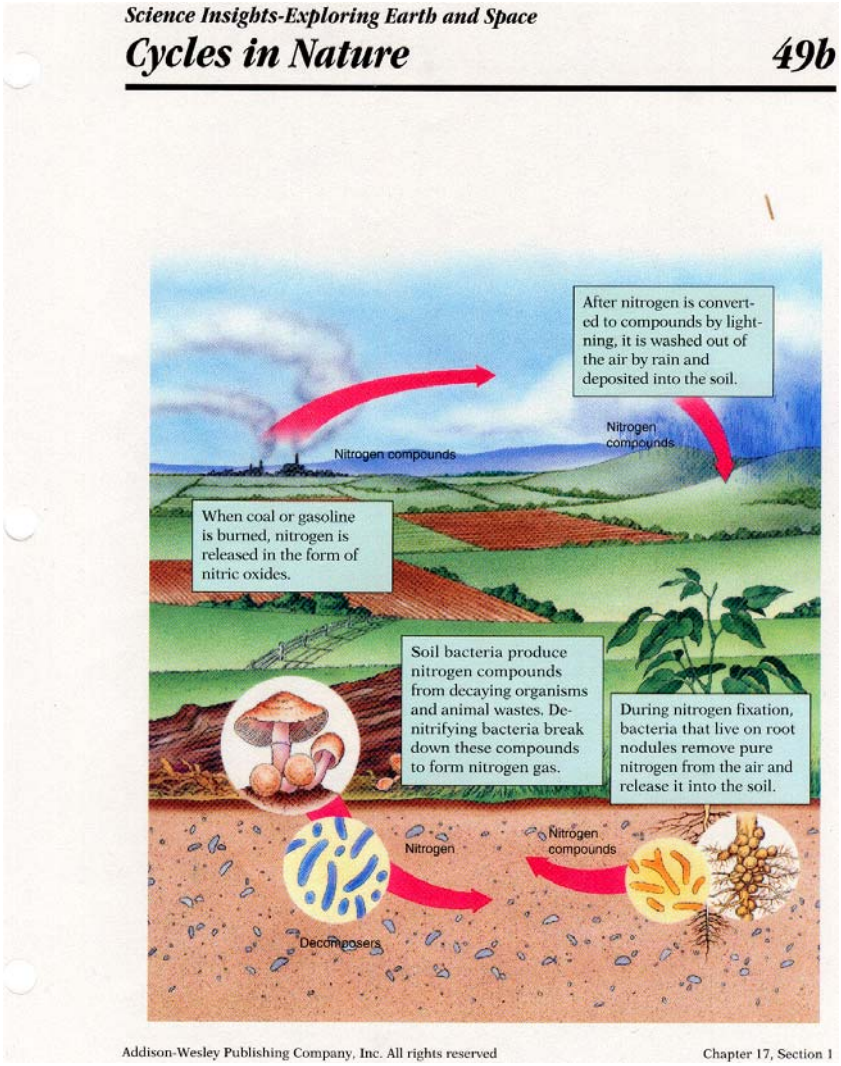


Figure 17: Cycles in Nature

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Discussion Question:

-What do you say to the myth that all bacteria are bad? Explain.

7) Make a connection between all of the cycles by discussing the transparency ***Soil Ecology***, F-18.

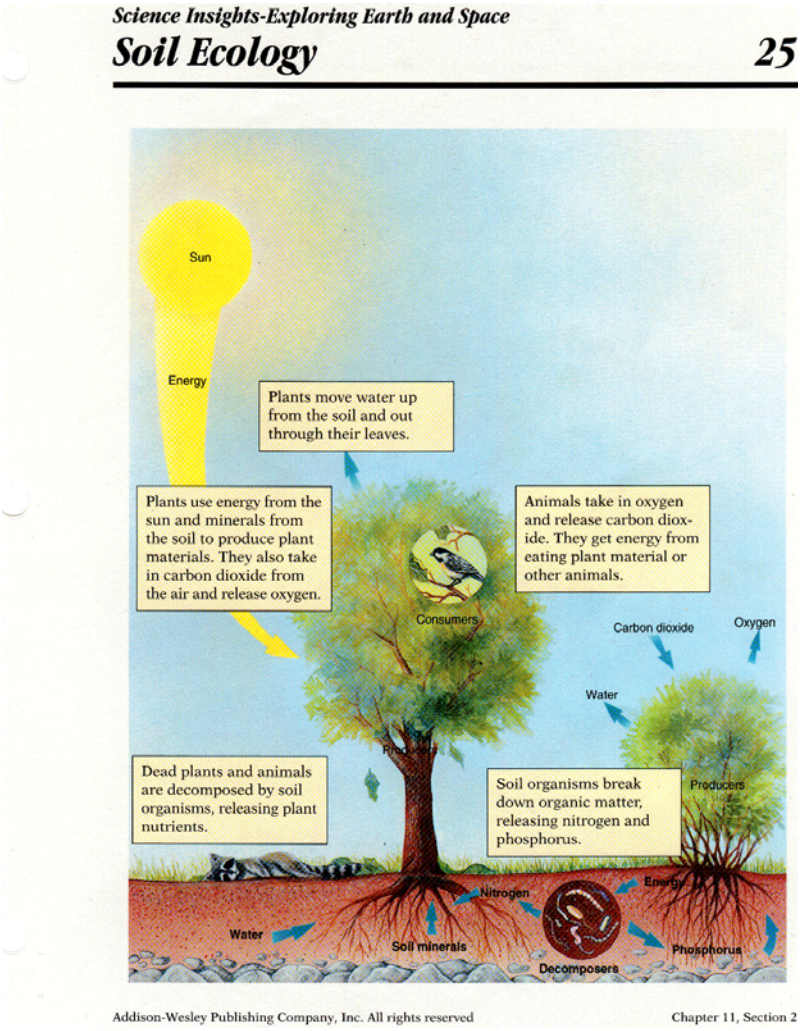

Figure 18: Soil Ecology

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Discussion Questions:

-What other cycles in nature are there? Explain.

Examples: rock cycle

food chain

waste decomposition

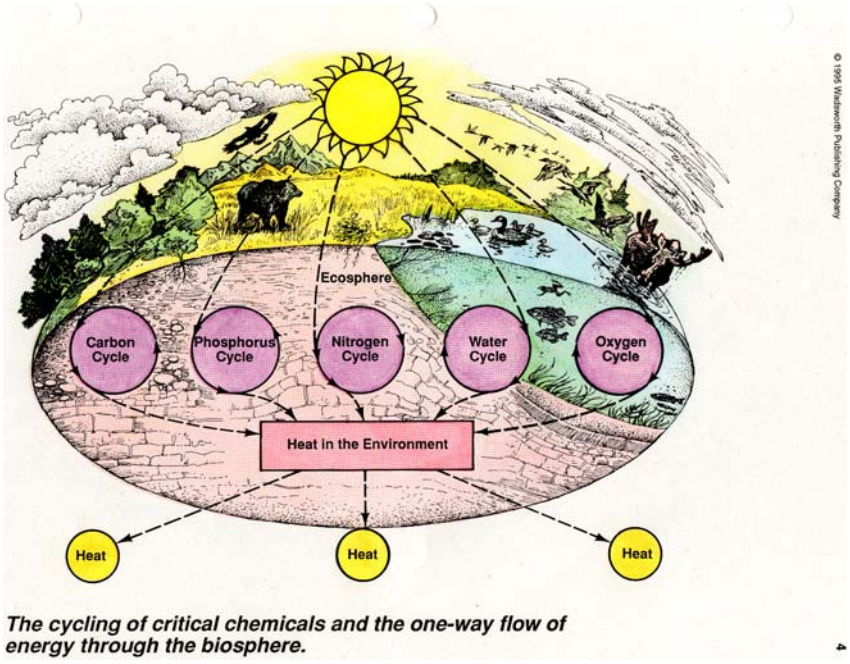

Figure 19: The Cycling of Critical Chemicals and the One-way Flow of the Energy Through the Biosphere. From *Environmental Science, 5th edition*, by G. T. Miller, Jr.. © 1995. Reprinted with permission of Brooks/Cole, a division of Thomson Learning. Fax 800 730-2215.

-What happens if any part of a cycle is hindered?

8) Relate the cycles to *Our Ecological Footprint* (discussion of chapters 1 and 2)

Key Statements for Discussion:

Location	Statement
Preface xi	The first step toward reducing our ecological impact is to recognize that the "environmental crisis" is less an environmental and technical problem than its a behavioral and social one.
Page 3	The Ecological Footprint concept is simple, yet potentially comprehensive: it accounts for the flows of energy and matter to and from any defined economy and converts these into the corresponding land/water area required from nature to support these flows.
Page 4	We argue that the human enterprise cannot be separated from the natural world even in our minds because there is no such separation in nature.
Page 7	Despite this estrangement, we are not just connected to nature -- we are nature.

Page 7	If we are to live sustainably, we must ensure that we use the essential products and processes of nature no more quickly than they can be renewed, and that we discharge wastes no more quickly than they can be absorbed.
Page 27	It may not be energy resources, but the waste assimilation capacity of our planet, that becomes most limiting. For example, while we used to be concerned about running out of fossil fuel, scientists now realize that CO_2 sinks are even scarcer (they're already filled to overflowing).
Page 56	Photosynthesis sustains all important food chains and maintains structural integrity of ecosystems.

Assignment:

Writing/Research assignment-

Refer to Page 29 of *Our Ecological Footprint.* Read the last paragraph and write a paper to describe your encapsulated city. Include the following:

-What will the planning process and land-use bylaws look

like?

-What sort of decision-making process would there be and who would be involved?

-What "trade-offs" and development costs that we currently ignore suddenly become very important?

-What criteria might be used to decide between private interests and the common good?

-Compare the desired planning process and legal regime with those currently in use in your community. Why are they different? Do these differences make sense?

Reading Assignment:

Chapter 3 of *Our Ecological Footprint*

Week Three:

RENEWABLE / NONRENEWABLE RESOURCES AND RISK ASSESSMENT

Thoughts for the Day (Amazing Eco-Facts and Figures):

-Americans make up 1/20 of the world's population, but use 1/4 of the world's energy.

-Each American's energy use is equal to that of 2 Japanese, 6 Mexicans, 13 Chinese, 32 Indians, or 372 Ethiopians.

Purpose:

To explain the differences and important uses of renewable and nonrenewable resources.

Objectives:

1) To describe nonrenewable resources:
   - -How they are used
   - -Their cyclical life
   - -Their environmental impacts
2) To describe renewable resources:
   - -How they are used
   - -Their cyclical life
   - -Their environmental impacts

Background Information:

1) Nonrenewable Vocabulary:

nonrenewable resource- resources that cannot be replaced as fast as they are being depleted (they take thousands of years to replenish)

Coal

Coal is a ***nonrenewable*** energy resource. It produces over 30% of the energy for the United States. Coal is known as a fossil fuel that is created from the remains of plants that died about 100 to 400 million years ago. These plants fell into swamps and over many years the layers built up. For some reason the decaying process was halted, and the extreme heat and pressures under the surface caused the plant matter to undergo chemical changes. With the oxygen being pushed out, what is left is rich hydrocarbon deposits that gradually turn into coal. The energy that we get from coal today is the energy that plants absorbed from the sun millions of years ago through photosynthesis.

Coal has five stages of development, peat, lignite, sub-bituminous, bituminous, and anthracite. Only the latter four are used in coal burning power plants. Lignite is the less efficient followed by sub-bituminous, bituminous, then anthracite. Anthracite coal is about 86 to 97% carbon making it the biggest energy producer when burned.

There are two ways in which to mine for coal. The first way is by surface mining. This type of mining requires that the coal usually be within 200 feet of the surface. To begin, the soil and rock covering the coal must be removed, this is known as the overburden. Once this has been removed the exposed seam of coal can be mined. The other type of mining is underground mining which is used when the coal is several hundred feet deep. A vertical shaft or slant tunnel is used to lower equipment and workers

to remove the coal. One type of underground mining is called room-and-pillar mining. This is a much more dangerous type of mining and much of the coal has to be left behind to keep the walls and roof from collapsing. The other type of underground mining (or it could be considered surface mining depending on the depth of the coal) is called longwall mining which uses a specially sheilded machine which allows the area to collapse in a uniform manner. Longwall mining allows for huge "walls" several hundred feet wide to be removed safely although it is much more costly.

The use of coal as an energy source has many downfalls. The major concern is "What is it doing to the environment?" The burning of coal releases sulfur dioxide into the air which contributes to acid rain. Another concern is that "What happens to the plant and animal life when an area is strip mined?" Recent laws have been passed to help with these concerns such as the Clean Air Act, the Clean Water Act and laws also require that an area be reclaimed after mining is finished. These laws all help regulate one of the most widely used energy resource in the United States. But, what if we run out? Remember that it is a nonrenewable resource that we need to use wisely.

Petroleum

Another nonrenewable energy resource is petroleum. It is also considered a fossil fuel because it was formed from the remains of tiny sea plants and animals from millions of years ago. These plants and animals sank to the bottom of the ocean and were buried and compacted into the sea floor. Layers and layers built up and after time the extreme heat and pressure cause it to change chemically. The geological conditions must trap the

oil rich rocks within non-porous rock that prevents it from leaking out. Only 2% of the organic matter actually transforms into oil.

Drilling for petroleum is a definitely a gamble. Only about 33 in every 100 exploratory wells have oil. Geologist look at and study underground rock formations to find areas that might contain oil. Still it is a hit or miss process, and once oil is found, it cannot be used in its natural form. It must be refined. This is a process that separates oil into different parts through distillation. All oil products have different boiling points and can therefore be separated. While in this phase all impurities are also removed.

Petroleum does not have all positive affects. There are several environmental concerns that are connected to petroleum. For example, air and water pollution are increased through the burning of petroleum byproducts and the affects of drilling for oil on the surrounding ecosystems is usually negative, not to mention the effects on the environment if there is an oil spill. All surrounding wildlife is in danger if such an occurrence takes place. Due to past experiences, there have been laws and emergency response teams put in place to help minimize such negative outbreaks.

Oil has become the leading source of energy in the United States, in the past few years. Our production cannot keep up with our demands, therefore we have to import part of our petroleum supply. This is significant because positive relations must be maintained for us to be able to receive imports from other countries. If we run out, and we will someday, we have to be able to buy supplies elsewhere or find alternative means of energy.

Natural Gas

Natural gas is formed the same way petroleum is formed, from the remains of tiny sea plants and animals that have been buried and compacted with extreme heat and pressure. Natural gas can be found by itself in porous rock or with petroleum deposits. It is mined in the same way as petroleum, yet the chances of finding it are 27 out of every 100. After natural gas is found it too goes to a processing plant to separate it into its different products and to remove impurities. Raw natural gas is a mixture of different gases with its main ingredient being methane and small amounts of propane and butane.

Natural gas is not as bad for the environment as the above spoken fossil fuels, but it does still have its drawbacks. It too, releases pollutants into the air when burned (although it is considered the cleanest burning fossil fuel), and the drilling processes have the same affects as drilling for petroleum. Therefore, using natural gas as a source of energy is still a concern for the environment, not to mention its limited reserves.

Nuclear Energy

Nuclear energy comes from the splitting of Uranium 235 atoms, known as fission. This is a process that splits atoms to release energy in the form of heat, radiation and more neutrons. Mining for Uranium is very cheap, however the process of creating a nuclear power plant is very expensive, therefore increasing the entire cost of nuclear energy. Although it takes less Uranium to produce an equivalent amount of energy produced by coal, probably the biggest concern to date is still the problem of what to do with the radioactive waste. Due to this problem, nuclear energy has been put on hold as an alternative for decreasing our fossil fuel consumption.

2) Renewable Vocabulary

renewable resource- capable of being replaced by natural ecological cycles

photovoltaic cell- a device made of two slices of silicon attached together with one having an excess of free electrons and the other having very few free electrons causing an electrical field.

Wind Energy

Wind is a ***renewable*** energy source because it is constantly flowing. Wind is created by the heating and cooling of the atmosphere. During the day land heats up faster than water; the air above the land rises and the cooler air above the oceans rush in to take its place. At night the cycle is reversed. This constant flow of energy can be harnessed.

Two types of wind machines are the horizontal wind machine and the vertical wind machine. The horizontal wind machine is used most often, making up about 95% of all wind machines. A typical machine could stand as tall as a 10-story building and have blades reaching out 60 feet across, although there are some that are much larger. A typical vertical wind machine stands about 100 feet tall and about 50 feet wide. The best way to describe it is that it looks like an “egg beater”.

Wind machines that are used for electricity are usually clustered together in what is called a wind farm. This is also known as a wind power plant. Most wind power plants are independently owned by businesses and they sell the electricity to utilities companies. Wind farms cannot be placed anywhere. They require a place that has at least a 14 mph wind to convert wind energy into electricity. They also take up hundreds of acres due to the fact that each machine needs at least two acres of space.

Wind energy is extremely efficient. Compared to a coal burning power plant they both convert about 30% of their energy into electricity. The drawback of wind machines is that they have a low capacity factor. For example, coal plants can produce over 75% of the time with little maintenance or down time, while wind power plants have only about a 25% capacity factor. They can only run when the wind is blowing.

As far as the environment is concerned, wind energy is an excellent alternative. It produces no air pollution and no water pollution; it is clean. The only drawbacks are that it affects the bird populations and some consider wind farms to be an eyesore. On the other hand, many see it as beautiful compared to smog-filled skies.

Solar Energy

Energy that comes from the sun is known as solar energy. The sun radiates more energy in one second than people have used from the beginning of time. The energy from the sun that hits the earth goes in many directions and is used for many purposes. About 15% of the energy is reflected back into space, 30% is used in the water cycle for evaporation, and then an undetectable amount is absorbed by plants, land and the oceans, but the rest could be harnessed to supply our energy needs.

Solar collectors can be used to collect light which can then be changed to heat to warm areas. This is known as solar space heating. There are passive heating systems and active heating systems. Passive solar homes have no special equipment. The entire house is built to be a solar collector. The architecture is positioned to work with the natural environment, for example, a house in the northern hemisphere would have windows on

the south side because that is where the sun shines. This house would have few or no windows on the north side to prevent the release of heat. Proper insulation is also very important for regulating the internal temperatures. Active solar homes use special equipment to aide in the light collection process. These solar collectors look like boxes covered with glass and dark-colored metal plates inside to absorb sunlight. They are placed high on roofs for maximum collection opportunities. The problem with these two systems is that storing heat is difficult, therefore backup systems such as wood-burning stoves might be needed.

Solar electricity is also possible through special equipment. This requires the aide of ***photovoltaic cells***. An electrical current will continue to flow as long as radiant energy strikes the cell, however PV cells are not very efficient. They only convert 10 to 14% of the radiant energy into electricity where as fossil fuels convert 30 to 40% of their fuel's energy into electricity.

Although solar energy is not very efficient, and after a solar system has been set-up (building photovoltaic cells requires products that are harmful) it has few harmful effects on the environment, therefore it has become known as one of the more environmentally friendly energy source. It does not contribute to air, water, or noise pollution and it cannot be controlled by any one nation. Even considering the total life cycle of solar power, it *is* an important alternative.

Hydropower

Hydropower, also known as waterpower, is energy that comes from the force of moving water. As we know, water is part of a continuous natural cycle that will always

be present as long as we have the sun. The flow of water has an enormous amount of kinetic energy that can be converted into mechanical energy and even into electricity.

A hydropower plant has three main parts, the electric plant, the dam, and a reservoir. The dam can open or close to control water flow, the reservoir is where water can be stored, and the electric plant is where the electricity is produced. To make electricity, the dam opens its gates from the reservoir, the fast-moving water turns a turbine which is connected to a generator to produce electricity.

Hydropower is the most widely used renewable energy source. It produces over 10% of this country's total electricity and 85% of Oregon and Washington's. Obviously, hydropower plants are easier to build where there is a natural waterfall, but they can be mechanically engineered.

Mechanically engineered hydropower plants are the biggest concern environmentally. Damming rivers disrupts the natural environment, especially for fish. They may also churn up metals from the soil from long ago, decreasing the water quality, and changes in water temperatures affect wildlife. However, these problems can be managed to some degree with careful regulation of plant operations.

On the positive side, hydropower is the cheapest way to generate electricity, because the flow of water is free. It is a natural process that is always replenished. Also dams control flood water, and reservoirs provide recreational areas for fishing, boating, and swimming.

Geothermal Energy

Geothermal energy is energy that comes from heat within the earth. It is considered renewable because this heat is continuously being produced from magma and the water it heats is part of the natural water cycle. In some areas magma comes very close to the surface where the crust has been thinned. Geologist can use methods to test for areas where geothermal energy may be found, but the only sure way is through drilling. The most active areas are usually around the plate boundaries but it can be found just about anywhere.

Geothermal energy has four main types, hydrothermal, geopressured, hot dry rock, and magma. The only type in wide use today is the hydrothermal. This type uses water and heat. Geothermal reservoirs occur naturally where magma comes close enough to the surface to heat ground water trapped in porous rock. These areas are tapped and used for many different energy purposes. A low temperature hydrothermal resource can be used directly. These have temperatures around 50 degrees F. It can be used to heat buildings, warm fish ponds, or used in spas. High temperature hydrothermal resources range from 220 to 1,000 degrees F. These resources can be used to produce electricity. The steam or hot water produced is used to propel turbine generators. The steam is then cooled and injected back into the system.

Geothermal power plants can produce electricity as cheaply as some fossil fuel burning plants. Once the plant is built the cost over time is lower because the fuel is stable and predictable. Environmental concerns are little, but the steam does contain naturally occuring traces of hydrogen sulfide and other gases that can be harmful in high

concentrations. Therefore geothermal plants use scrubber systems to clean the air or they inject these gases back into the wells. Other than that they are somewhat environmentally friendly.

Biomass

Biomass is the oldest source of energy. It is any organic matter that can be collected to release energy. All biomass received its energy from the sun through photosynthesis before it died. There are four ways in which we can use biomass energy. The first way is by burning it. This can produce steam for making electricity or the heat can be used directly. The second way biomass can be used is through bacterial decay. This is a natural process of bacteria feeding on dead plants and animals, producing methane gas, and remember, methane gas is a byproduct of natural gas used by utilities. The third use of biomass is fermentation. Adding yeast to biomass produces an alcohol called ethanol, which is how wine, beer, and liquor are made. The fourth and final use of biomass energy is that it can be converted to gas or liquid fuels by adding chemicals or heat.

Power plants that burn biomass (garbage) for energy are called Waste-to-Energy plants. These plants operate much like a coal burning plant, but burning biomass is not as cost effective, yet it decreases the amount of garbage dumped into landfills by 60 to 90% and reduces landfill costs of disposal.

Landfill gases, such as methane are required to be collected due to environmental concerns and for the benefits it can provide. This gas can be purified and used as an energy source for gas furnaces and gas stoves.

Biomass is a wonderful energy source alternative to its fossil fuel counterparts if it can ever become cost effective. Who knows, at the rate we are consuming our nonrenewable resources, maybe it is more within reach than we think.

Risk Analysis

A risk is the possibility of suffering harm from a type of hazard that may result in injury, disease, economic loss, or environmental damage. The four most common hazards are: cultural hazards such as unsafe living and working conditions; chemical hazards which result from harmful chemicals in the air, water, soil, or food; physical hazards which include natural disasters and radiation; and biological hazards which are disease-causing viruses and bacteria, pollen, parasites, and poisonous animals. There is no where on Earth that has zero risks. Therefore, a risk assessment must be taken involving all environmental issues to prevent unnecessary suffering of humans or the environment. A thorough analysis/assessment involves using data, assumptions, and models to estimate the probability of harm that may result from specific hazards. For example, the decision to use renewable verses nonrenewable resources requires a highly thought out process to weigh the effects towards the environment and to humans.

Materials:

Our Ecological Footprint by Mathis Wackernagel and William Rees

CD: Project Earth Risk Identification Lifeline (computer with projection screen)

Transparencies:

Thought for the Day

Major Coal Fields in North America (F-20)

Energy Resources from Earth's Crust (F-21)

Radiant Energy (F-22)

Solar Envelope House (F-23)

Solar Heating System (F-24)

Availability of Solar Energy in North America During the Day (F-25)

Resources (F-26)

Procedures:

1) Discuss coal as a nonrenewable resource.

-How it is formed

-Types of coal

-How it is mined

-What effects does it have on the environment?

-Where can it be found? (use transparency ***Major Coal Fields in North America*** F-20)

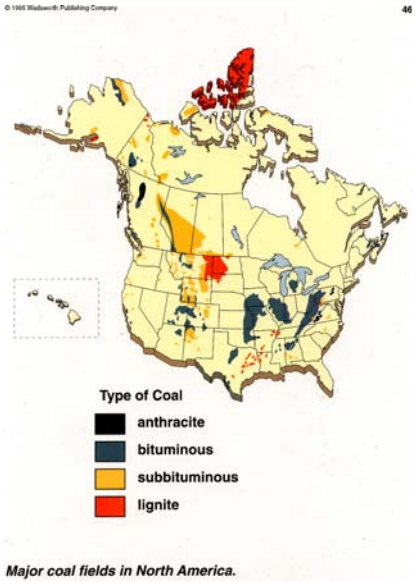

Figure 20: Major Coal Fields in North America

From *Environmental Science, 5th edition*, by G. T. Miller, Jr.. © 1995. Reprinted with permission of Brooks/Cole, a division of Thomson Learning. Fax 800 730-2215.

Data from Council on Environmental Quality

2) Discuss petroleum as a nonrenewable resource.

-How it is formed

-How it is mined

-Effects it has on the environment

-Concerns about demand

3) Discuss natural gas as a nonrenewable resource.

-How it is formed

-How it is mined

-Effects it has on the environment

4) Mention nuclear energy as a nonrenewable resource.

-Explain how it is not a viable alternative due to its waste disposal problems.

5) Discuss all of the energy resources that come from the earth. Use transparency ***Energy Resources from the Earth's Crust,*** F-21.

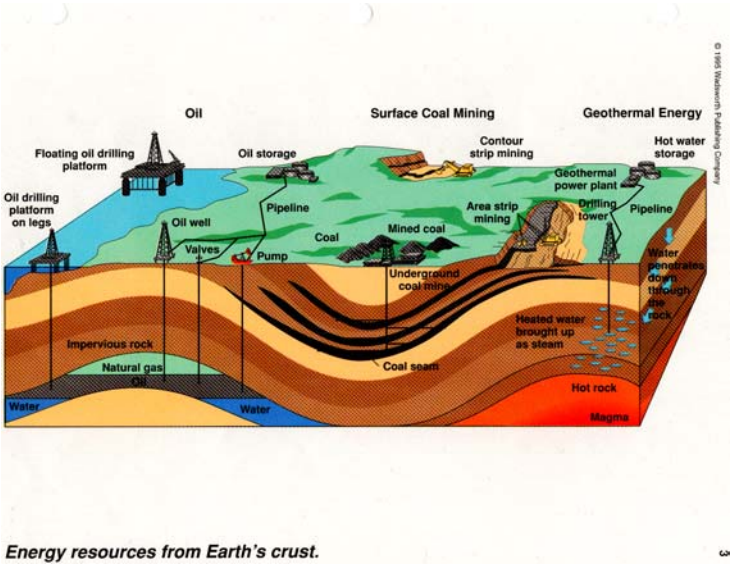

Figure 21: Energy Resources from Earth's Crust

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Discussion Questions:

-What are the similarities and differences in the resources already mentioned?

-How is geothermal energy different from coal, petroleum, or natural gas?

6) Discuss wind energy as a renewable energy source.

-How wind is created (its cyclical nature)

-Types of wind machines

-Efficiency

-Environmental concerns

7) Discuss solar energy as a renewable resource. Use the transparency ***Radiant Energy***, F-22.

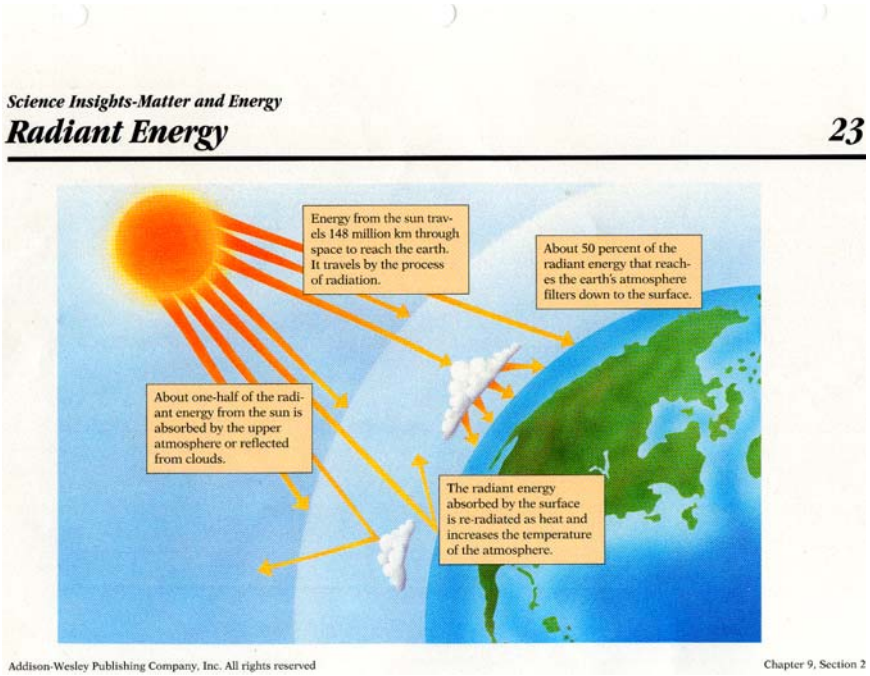

Figure 22: Radiant Energy

From *Science Insights: Exploring Matter and Energy* © by Addison-Wesley Publishing Company, Inc. Used by permission.

-Uses of solar energy (water cycle, plants, energy needs)

-Types of solar collectors/ heating systems (use transparency ***Solar Envelope House***, F-23 and ***Solar Heating System***, F-24)

-Solar energy intensities (use transparency ***Availability of Solar Energy in North America During the Day***, F-25)

-Environmental concerns

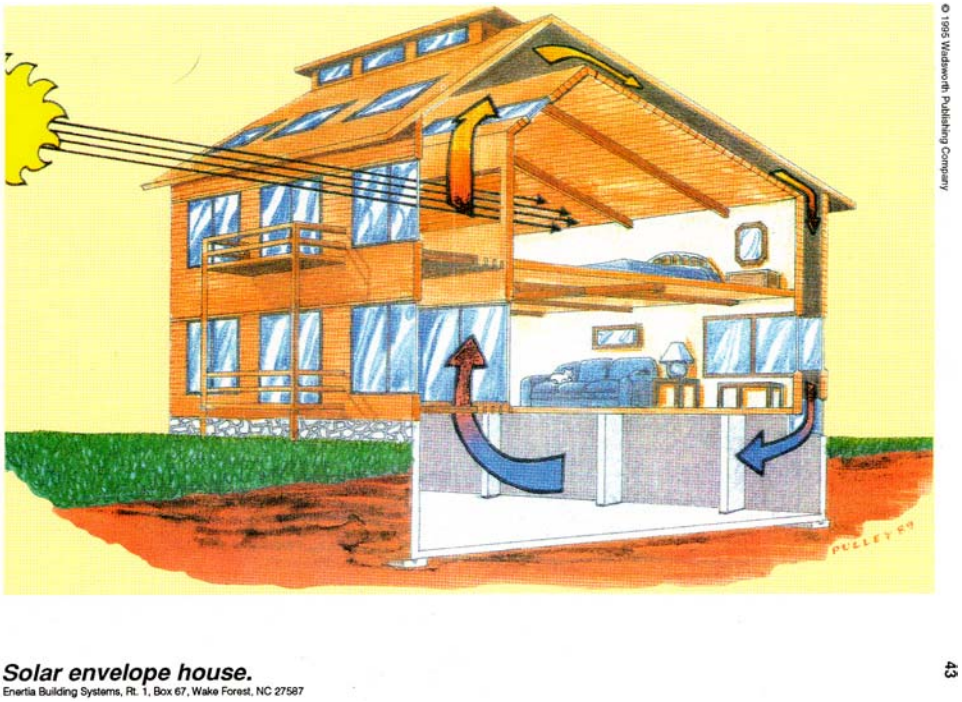

Figure 23: Solar Envelope House

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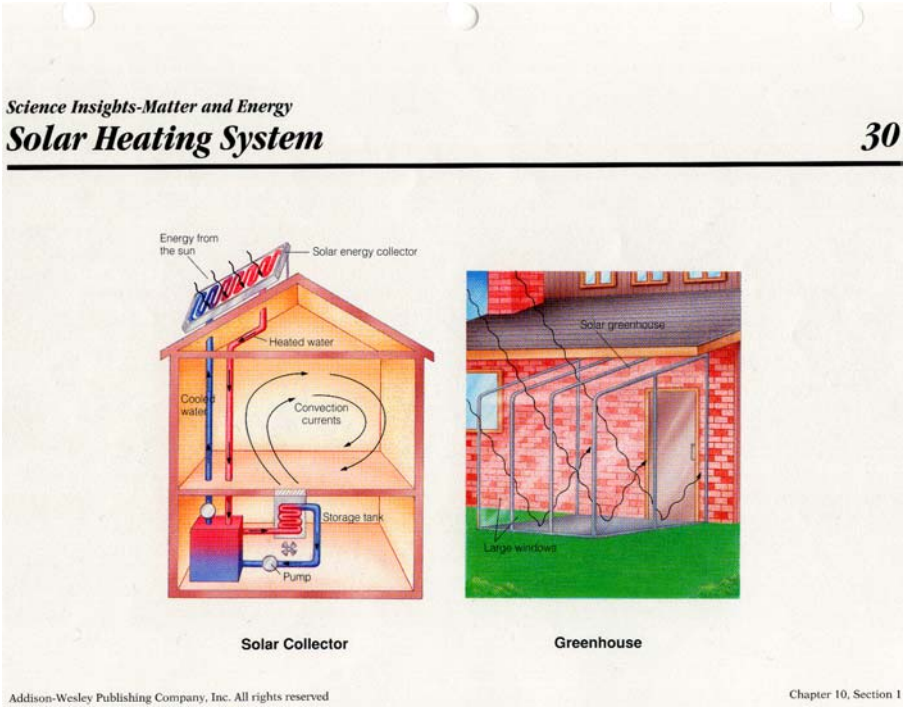


Figure 24: Solar Heating System

From *Science Insights: Exploring Matter and Energy* © by Addison-Wesley Publishing Company, Inc. Used by permission.

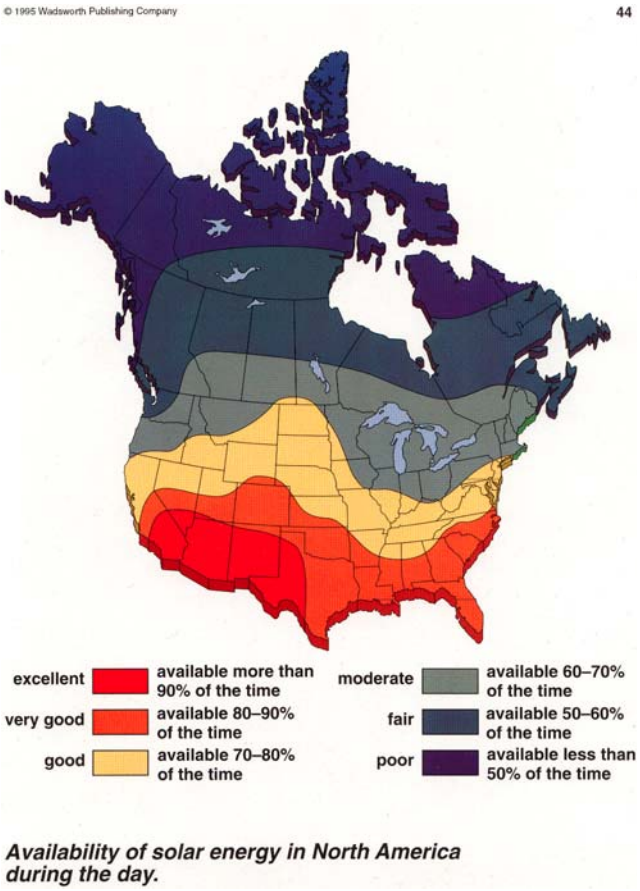


Figure 25: Availability of Solar Energy in North America During the Day

From *Environmental Science, 5th edition*, by G. T. Miller, Jr.. © 1995. Reprinted with permission of Brooks/Cole, a division of Thomson Learning. Fax 800 730-2215.

Data from U.S. Department of Energy and National Wildlife Federation

8) Discuss hydropower as a renewable energy source.

-Its cyclical nature

-Parts of a plant

-Statistics

-Environmental concerns

9) Discuss geothermal energy as a renewable energy source.

-What is it?

-Environmental concerns

-Where can it be found?

10) Discuss Biomass as a renewable energy source.

-What it is

-How it can be used

-Waste-to-Energy plants

-Effects on the environment

11) Summarize resources. (Show transparency ***Resources***, F-26)

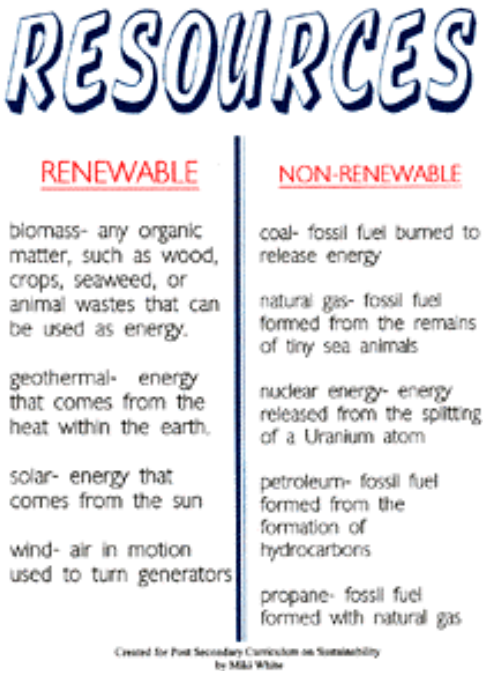


Figure 26: Resources

12) Discuss risk analysis.

-What is a risk?

-What is a cultural hazard? Chemical hazard? Physical hazard? Biological hazard?

-**If time allows play PERIL (Project Earth Risk Identification Lifeline). This can be played as a class or in small groups.

13) Relate renewable/nonrenewable resources and risks to *Our Ecological Footprint*.

Key Statements for Discussion:

Location	Statement
Page 24	Clearly, improved technologies are essential. Even simple things like solar water heaters or better insulation in our houses can reduce our footprint without compromising our material standards of living.
Page 26	Energy is the driving force of the human enterprise. If we have enough energy, we can do anything we like: clean up the environment, irrigate deserts, build fast transportation networks, power highly productive greenhouses-- you name it!

Page 27	It may not be energy resources, but waste assimilation capacity of our planet, that becomes a most limiting. For example, while we used to be concerned about running out of fossil fuel, scientists now realize that CO_2 sinks are even scarcer (they're already filled to overflowing).
Page 27	Solar energy, with all its necessary equipment, will be more expensive, and we will use it more wisley. However, with a solar economy we should be able to secure a higher future quality of life.
Page 35	. . . nonrenewable forms of natural capital such as fossil fuel and minerals are analogous to inventories. Any use implies liquidating part of the stock. Since adequate stocks of self-producing and replenishable natural capital are essential for life-support . . . we consider these categories of natural capital to be more important to sustainability than non-renewable forms.
Page 69	Table 3.2 Productivity of Various Energy Sources

Page 72	. . . sustainable economy requires a sustainable energy supply, i.e., it should not be dependent on depletable fossil capital.
Page 73	. . . any society using non-renewable resources should invest a portion of the revenues so generated in building up an equivalent value of manufactured capital or renewable resource assets.
Page 75	. . . nuclear power is not a viable energy option today.

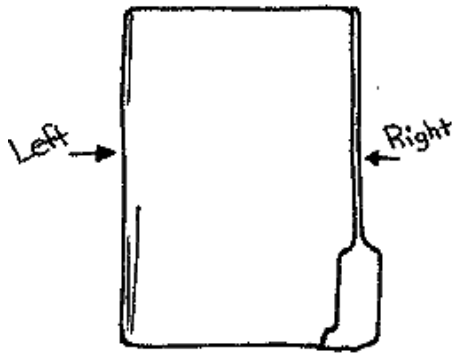
Assignment:

Project:

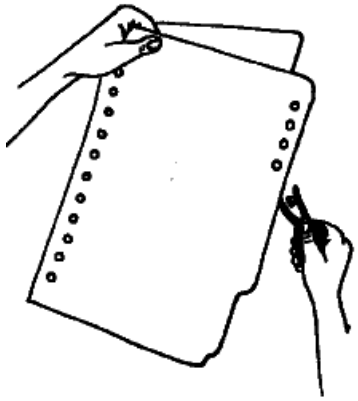
Circuit Board- Create a circuit board to link one interesting fact to each of the energy sources. The file folder circuit board is an option, but feel free to use any materials and be as creative as possible. The project is due by week 6 before the Test.

Circuit Board File Folder:

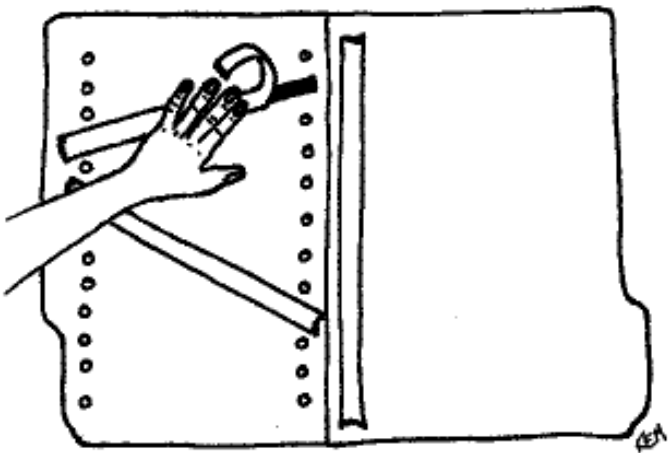
1) Take a normal file folder and write the energy sources down the left-hand side of a closed file folder.
2) Write an interesting fact about each of the energy sources down the right-hand side of the closed file folder (make sure you mix them up).



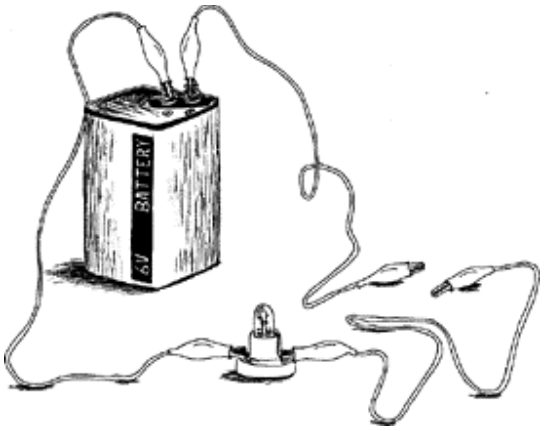
3) Punch a hole next to each energy source (this will go through both layers of the file folder because the hole punch will not reach to the middle).
4) Open the folder slightly and punch a hole next to each interesting fact.



5) Open the file folder and connect the correct answers with aluminum foil. Do one at a time and cover each with masking tape. *Make sure no foil is showing before you lay the next piece, or your circuits will be crossed.



6) Using a battery, socket, lightbulb, and alligator clips complete the circuit to play the game. *If the energy source is matched with the correct interesting fact then the light will light up.



Illustrations drawn by Karen McGinnes

Reading Assignment:

Finish *OurEcological Footprint*

Week Four:

POPULATION DYNAMICS

Thoughts for the Day (Amazing Eco-Facts and Figures):

-In the time it takes you to read this sentence, there will be 18 more people added to the planet.

-At the current rate of growth, the world population would double in just 45 years.

Purpose:

To explain how increasing population severely strains the earth's capacity to sustain us all.

Objectives:

1) To explain population growth and the factors that contribute to it.
2) To incorporate density-dependent and density-independent factors into the environmental limits of population growth.
3) To explain how carrying capacity is the ultimate factor in population growth.
4) To relate population to environmental problems such as resource consumption.

Background Information:

Vocabulary:

population- a group of individuals of a single species living together

ecosystem- community of living and nonliving things with its environment

niche- role of a particular species in a community regarding food, space, reproduction, and how it interacts with abiotic factors

density-dependent factor- effects that limit the size of a population, such as predation, disease, competition for food, water, and territory

density -independent factor- factors that affect a population regardless of the population size, such as weather and physical disturbances

exponential growth- explosive population growth in which the number of reproducing individuals increases by an ever increasing rate

carrying capacity- maximum, stable population size an environment can support over time. It oscillates around the mean do to the fact that characteristics of a place change.

All ***populations***, whether plant, animal, or human, have characteristic features such as size, density, dispersion, and demography. Every population occupies a particular place and has a particular role within its ***ecosystem***. This role is known as its ***niche***. If this role is interrupted or disturbed in any way it will effect surrounding populations (this relates back to the first lesson, that explains how everything works in cycles). The size of the population however and the type of disturbance will ineffect determine the severity

of the disruption. Very small populations have the greatest chance of failure due to shear numbers, while larger populations usually have a better chance of survival.

Discussing numbers, population growth is a result of the number of reproductive organisms increasing which in turn increases offspring. This creates what is called an ***exponential growth*** curve also known as a "J" curve due to its J like shape. With this in mind, one would think that populations could grow indefinitely, but many other factors come into play.

Although the size of a population is important, its density and dispersion are probably bigger factors when it comes to survival. ***Density-dependent factors*** such as disease and competition are closely linked to more densely populated areas. For example, when members live close together a disease can spread more quickly rather than if they lived further apart. While on the other hand, ***density-independent factors***, such as weather, will have adverse affects no matter how densely populated the area.

No matter how strong a population is, it cannot grow indefinitely. Limiting factors such as the ones listed above and environmental limiting factors such as space, light, water, or nutrients help to regulate the size of a population. With these limits in place an environment creates what is called its ***carrying capacity***. This becomes another variable in the equation of population growth. When a population overshoots the carrying capacity of its environment, deaths will start to exceed births and the population levels will fluctuate until they can balance within the environment.

As far as human population growth, the increasing number of inhabitants on earth is having adverse affects on our environment. Overpopulation is a debatable term due to

the fact that we cannot statistically prove that we have reached our planet's carrying capacity, but what we do know is that the increasing population is causing types of environmental degradation. "Overpopulation", for lack of a better word, is causing resource shortages, increased pollution, and many other environmental and social problems. The world view is that population growth is one of the main concerns of the present and of the future.

Materials:

Our Ecological Footprint by Mathis Wackernagel and William Rees

Transparency:

Thought for the Day

Interactions Among Environmental, Resource, and Social Problems (F-27)

Procedure:

1) Discuss the dynamics of a population within its ecosystem.

-size

-density

-dispersion

-demography

2) Discuss population growth.

-exponential growth

-density-dependent factors

-density-independent factors

-carrying capacity

3) Discuss the affects of "overpopulation" on the environment.

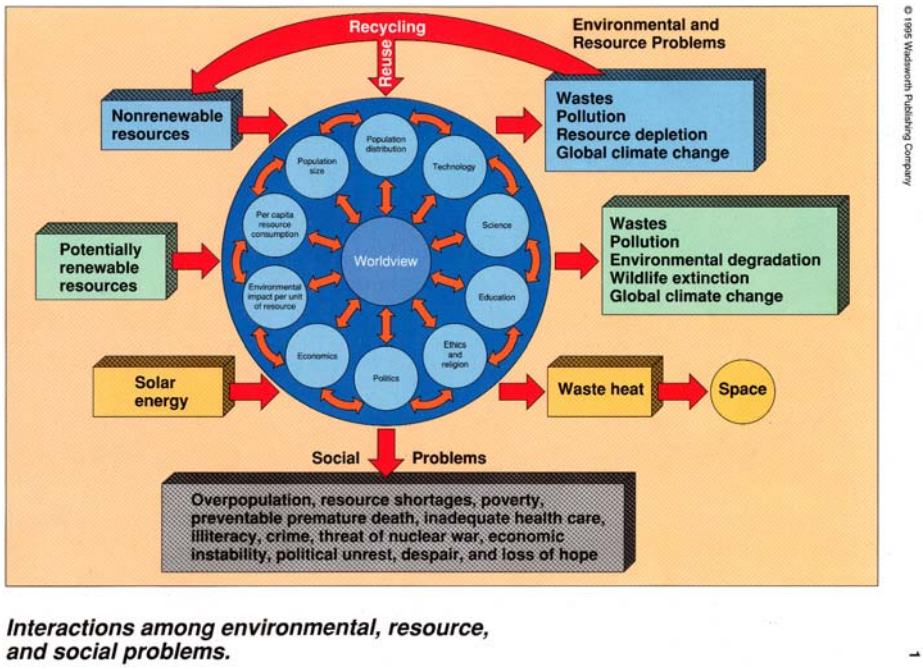
-pollution

-resource depletion

-poverty

-social strains

4) Use the transparency ***Interactions Among Environmental, Resource, and Social Problems***, F-27 to discuss the "cycle" involving population.



Interactions among environmental, resource, and social problems.

Figure 27: Interactions Among Environmental, Resource, and Social Problems From *Environmental Science, 5th edition*, by G. T. Miller, Jr.. © 1995. Reprinted with permission of Brooks/Cole, a division of Thomson Learning. Fax 800 730-2215.

Discussion Questions:

-Do you feel the size of the human population is an important

environmental issue?

-Do you feel consumption by the human population is an important environmental issue?

-Do you feel that humans have the right to have as many children as they want? Are there any limits on this right? If so, what are they?

Assignments:

Opinion Writing-

Write a short essay answering the following questions.

-Do you feel that there should be a national or even world population policy? Why or why not? What steps would you support?

Project-

Continue working on circuit board. Due week 6 before the test.

Week Five:

CARRYING CAPACITY

Thought for the Day (Amazing Eco-Facts and Figures):

Tropical forests cover only 7% of the earth's surface, but house over half of all the plant and animal species in the world.

Purpose:

To explain Earth's carrying capacity and the limiting factors within it.

Objectives:

1) To describe how carrying capacity affects exponential growth.
2) To stress that our goal is not to reach the Earth's carrying capacity.
3) To define Earth capital and describe ways to conserve it.

Background Information:

Vocabulary-

earth capital- earth's natural resources and processes that sustain us and other species

environmental resistance- all the limiting factors jointly acting to limit the growth of a population

sustainable yield- highest rate at which a potentially renewable resource can be used without reducing its available supply throughout the world or in a particular area

Carrying capacity, as defined last week, is the number of individuals of a given species that can be sustained indefinitely in a given area. It is limited by many factors and its limits are constantly changing. Carrying capacity can vary season to season, or when supplies of food, water, space, or nutrients fluctuate. These ***environmental resistances*** cause populations to also fluctuate. When a population overshoots the carrying capacity for its surroundings, the population will experience a dieback or crash until it reaches an equilibrium with its environment.

Humans are not exempt from experiencing a dieback or crash in population. There have been many reported cases of human population crashes due to fungi, disease, or other natural disasters (these are related to density-dependent and density-independent factors within populations as discussed last week).

Humans are also known for increasing an area's carrying capacity due to technology. We have increased food supplies, controlled diseases, and increased habitable areas by transporting energy. The question at hand is, how long can we keep it up living on a planet with finite resources.

We have to start living on the earth's income rather than its capital. ***Earth capital*** such as water, soil, forests, grasslands, wildlife, resources, and natural processes such as purification and recycling, all have time constraints on replenishing themselves. The earth must be able to maintain a ***sustainable yield***. We need to allow them time to absorb, dilute, or degrade to be able to restore. As we use more and more of the earth's capital, its carrying capacity is decreased.

Materials:

Our Ecological Footprint by Mathis Wackernagel and William Rees

Transparency:

Thought for the Day

How Many People Can the Earth Support? (F-28)

Projected Population Growth: J Curve (F-29)

Food (optional)

Procedure:

1) Demonstrate carrying capacity by introducing a limiting agent.

   Examples:

   -Bring in some sort of food, but not enough for everyone environmental resistance- food).

   -Take out several chairs from the room requiring some students to stand (environmental resistance- space).

   -Pass out some sort of hot candy/food to everyone. Have fewer cups of water available requiring some to do without (environmental resistance-water)

2) Place the transparency ***How Many People Can the Earth Support?***, F-28 on the overhead. Read aloud.

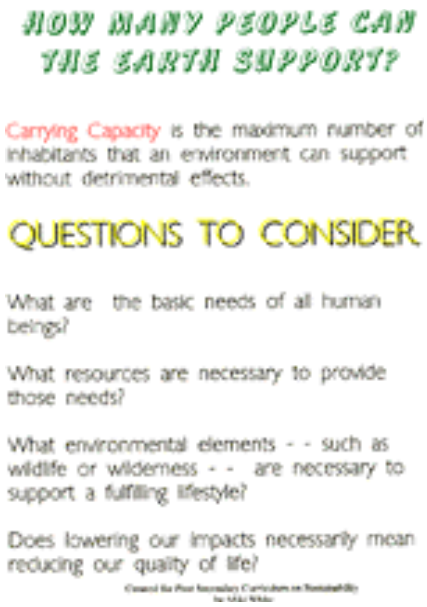


Figure28: How Many People Can the Earth Support?

3) Discuss environmental resistances on carrying capacity.

-water supply

-food

-space

4) Discuss how humans can increase carrying capacity.

-technologies

-increased food supply

-vaccines

5) Use transparency ***Projected Population Growth: J Curve***, F-29 for discussion.

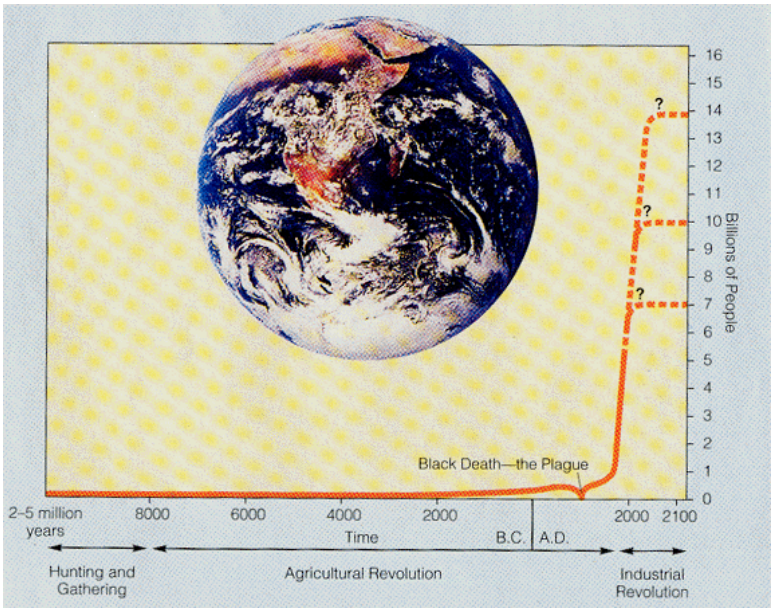


Figure 29: Projected Population Growth: J Curve

From *Environmental Science, 5th edition*, by G. T. Miller, Jr.. © 1995. Reprinted with permission of Brooks/Cole, a division of Thomson Learning. Fax 800 730-2215.

Data from World Bank and United Nations

Discussion Questions:

-Do you feel the earth will be able to "carry" (sustain) the projected increases in population?

-Do you believe the J curve will continue?

6) Relate carrying capacity to *Our Ecological Footprint*.

Key Statements for Discussion:

Location	Statement
Page 11	. . . land is required to support any specific lifestyle indefinitely, the Ecological Footprint concept demonstrates the continuing material dependence of human beings on nature.
Page 25-26	. . . humanity must live within global carrying capacity. It also maintains that if we choose wisely it might even be possible to increase our quality of life.
Page 35	. . . Earth's "natural capital" is more than just an inventory of industrial resources; it comprises also those components of the ecosphere, and the structural relationships among them, whose organizational integrity is essential for the continuous self-production and self-regulation of the system itself.
Page 43	The Second Law of Thermodynamics states that the entropy of an isolated system always increases. This means that the system spontaneously runs down.

Page 48 The oral history of concern about the relationship between people and land must go back thousands of years.

Page 50 . . . shrinking carrying capacity may soon become the single most important issue confronting humanity.

Page 51 . . . the total ecological load imposed by any population will vary with such factors as average income, material expectations, and the level of technology (e.g., energy and material efficiency). In short, human carrying capacity is as much a product of cultural factors as it is of ecological productivity.

Assignment:

Project-

Finish circuit board. Due next week before test.

Study-

Prepare for first exam.

Reading-

The first three chapters of *The Ecology of Commerce* by Paul Hawken

Week Six

PROJECT PRESENTATIONS/

SUSTAINABILITY: EXAM 1

Thought for the Day (Amazing Eco-Facts and Figures):

-If all U.S. homes turned their heat down by six degrees in the winter, we would save 500,000 barrels of oil each day.

Materials: Transparency (optional)

Project Presentations:

All class members will give a five to seven minute presentation describing and demonstrating their circuit board creation. (Times will vary depending on number of students in the class.)

Exam:

The exam consists of fifty questions. Thirty multiple-choice, fifteen true/false, and five essay/short answer. Allow at least two hours if all questions are used.

Answer Key:

1) B	11) C	21) D	31) T	41) T
2) D	12) B	22) A	32) F	42) F
3) C	13) D	23) D	33) F	43) T
4) B	14) D	24) A	34) F	44) F
5) B	15) A	25) C	35) T	45) T
6) B	16) D	26) B	36) T	
7) C	17) A	27) D	37) T	
8) D	18) D	28) C	38) T	
9) A	19) B	29) A	39) F	
10) B	20) C	30) B	40) F	

46) Answers will vary depending on the cycle chosen.
47-50) These are all opinion questions. Look for support for their reasoning.

Name _____ Instructor _____ Section _____

SUSTAINABILITY: EXAM 1

MULTIPLE CHOICE: Choose the appropriate letter that best answers the question.

1) Americans make up 1/20 of the world's population, but use _____ of the world's energy.

   a) ½
   b) ¼
   c) 1/5
   d) 2/3

2) The wise use of the Earth's natural resources was defined by Pinchot to be _____.

   a) reclamation
   b) preservation
   c) environmentally friendly
   d) conservation

3) Although ¾ of the earth is covered by water, less than _____ is readily available for human use.

   a) 3 %
   b) 5 %
   c) 1 %
   d) 2 %

4) The Reclamation Act was established in what decade?

   a) 1890-1899
   b) 1900-1909
   c) 1910-1919
   d) 1920-1929

5) The Decade of environmental command and control by the government was the ____.

a) 1960's
b) 1970's
c) 1980's
d) 1990's

6) All of the following are renewable resources except _____.

a) wind
b) nuclear
c) geothermal
d) biomass

7) The maximum number of inhabitants that an environment can support without detrimental effects is its _____.

a) load
b) biological number
c) carrying capacity
d) biological capacity

8) The three fossil fuels formed from the remains of tiny sea creatures are

a) propane, coal, and natural gas
b) natural gas, coal, and petroleum
c) coal, propane, and petroleum
d) propane, natural gas, and petroleum

9) Development that meets the needs of the present without compromising the ability of future generations to meet their own needs, is the definition of sustainability given by

a) The Bruntland Commission
b) British Government
c) Gifford Pinchot
d) The EPA

10) Gifford Pinchot was named Chief Forester by

a) President Kennedy
b) President Theodore Roosevelt
c) Secretary of State Baker
d) President Truman

11) The well known environmental literature written by Aldo Leopold was titled

a) *Should Trees Have Standing*
b) *Silent Spring*
c) *Land Ethic*
d) *Ecological Footprint*

12) The National Park System was established in

a) 1900
b) 1912
c) 1930
d) 1963

13) Earth's capital includes all of the following except

a) wildlife
b) water
c) air
d) buildings

14) Exponential growth over time is characteristic of

a) resource consumption
b) population growth
c) pollution and environmental degradation
d) all of the above

15) The conversion of solar energy into chemical energy occurs in

a) photosynthesis
b) food chains
c) decomposers
d) carbon cycle

16) All of the following increase the amount of carbon dioxide in the air except

a) volcanic eruptions
b) combustion
c) respiration
d) photosynthesis

17) Two ways in which humans have most interfered with the carbon cycle are

a) burning of fossil fuels and removal of forest
b) aerobic respiration and removal of forest
c) aerobic respiration and burning of fossil fuels
d) burning of fossil fuels and causing volcanic eruptions

18) The hydrologic cycle refers to the movement of

a) hydrogen
b) hydrocarbon
c) oxygen
d) water

19) Population dynamics include all of the following except

a) size
b) economic status
c) density
d) dispersion

20) An exponential curve is also known as a/an _____ curve.

a) S
b) L
c) J
d) U

21) Density-independent population factors include all of the following except

a) drought
b) fire
c) temperature changes
d) resource competition

22) All of the following elements are major components of living organisms except

a) calcium
b) carbon
c) oxygen
d) nitrogen

23) Density-dependent population factors include all of the following except

a) competition of resources
b) disease
c) predation
d) natural disasters

24) Homes that have no special equipment, yet are built to be a solar collector are called

a) passive solar homes
b) active solar homes
c) inactive solar homes
d) energy conservers

25) The renewable energy source known as the most environmentally friendly is

a) geothermal energy
b) nuclear energy
c) solar energy
d) hydropower

26) The oldest source of energy *collected* to release energy is

a) hydropower
b) biomass
c) wind
d) geothermal

27) The type of coal that contains the most carbon and is most efficient is

a) peat
b) lignite
c) bituminous
d) anthracite

28) Energy

a) recycles through the ecosystem
b) originates at the center of the earth
c) flows in only one direction
d) is concentrated by living organisms

29) A group of individuals of the same species occupying a given area is called a

a) population
b) community
c) niche
d) genus

30) All of the following represent a *cycle* except

a) food chain
b) energy
c) hydrologic
d) photosynthesis

TRUE/FALSE: Answer the following statements as true or false by circling the appropriate response..

T F 31) Nuclear energy is non-renewable.

T F 32) We could *run out* of water.

T F 33) All cycles in nature are biotic.

T F 34) Everyone's biological clock is on the same time.

T F 35) Organisms (excluding bacteria) cannot use Nitrogen in the air directly.

T F 36) Matter cannot be replenished, therefore it must be recycled.

T F 37) Maintaining a constant internal environment is called homeostasis.

T F 38) Some entire life expectancies are based on annual rhythms.

T F 39) Petroleum can be used in its natural form.

T F 40) The most widely used wind machine is the vertical wind machine.

T F 41) The most widely used and most efficient renewable energy used today is hydropower.

T F 42) Natural weather disasters are density-dependent population factors.

T F 43) A population J curve cannot continue forever.

T F 44) Overpopulation can be measured.

T F 45) Earth capital includes wildlife.

ESSAY/SHORT ANSWER: Write complete sentences to answer the following questions. Remember to support your answers. You may use extra paper if needed.

46) Choose any cycle in our ecosystem and describe it in detail.

47) Choose the renewable resource that you believe is the best alternative energy source and tell why. Would it work in Denton, Texas?

48) What do you believe has been the most influential accomplishment for humans increasing the carrying capacity of our planet?

49) Can and should population be controlled?

50) What have you personally done in the past six weeks to contribute to reaching a more sustainable planet?

Week Seven

LAND USE

Thought for the Day (Amazing Eco-Facts and Figures):

There are more shopping malls than high schools in the United States.

Purpose:

To explain the importance of ecological land-use planning.

Objectives:

1) To describe the difference in land-use planning and *ecological* land-use planning.
2) To explain the disruptions caused by urban sprawl.
3) To describe the importance of soil.

Background Information:

1) Vocabulary:

Land-use planning- strategies used to decide the best present and future use of land in an area (usually based on the assumption that growth in population and economic development should be encouraged regardless of the environmental consequences)

Ecological land-use planning- land-use planning in which all aspects are considered including geological, ecological, economic, health and social factors.

Zoning- designating a specific use of a given piece of land.

Multiple land-use- type of regulation that allows more than one use of the land at the same time.

Urban sprawl- unplanned growth in suburban areas

Quoted from Environmental Science: A Study of Interrelationships by Enger and Smith, "Currently in the United States, about 47 percent of the land is used for crops and livestock, about 45 percent is forests and natural areas, and nearly 5 percent is used intensively by people in urban centers and as transportation corridors".

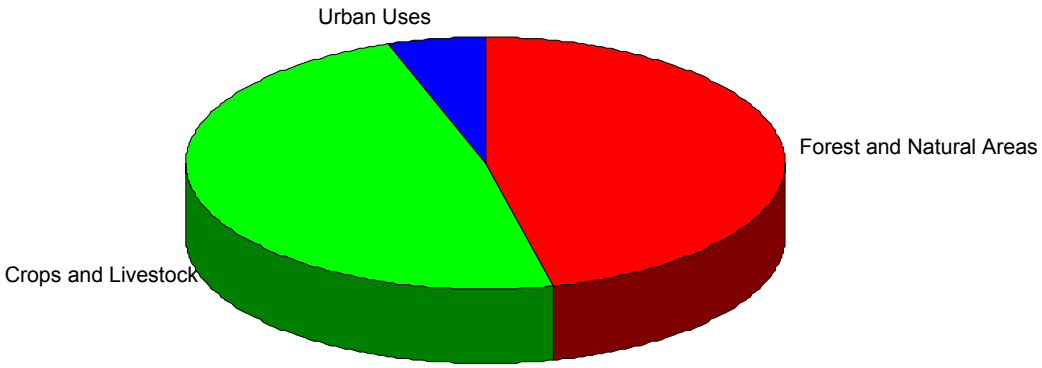


Figure 30: Land Use in the United States

All land on earth should be considered a nonrenewable resource. Once land has been used for a certain purpose, it is hard to convert it for any other use. With the ever-increasing population it is even more important for a change in ***land- use planning***. Just

considering economics and growth is not enough anymore. The environment along with health and social factors should have equal consideration in land use decisions. We need ***ecological land-use planning***. This sounds easy to do, but economic and political pressures cause quick decision making to solve short-term problems.

Urban sprawl is one of the reasons today why we cannot see where one city ends and another begins. With unplanned urban growth, many problems arise. Transportation, loss of farmland, floodplain problems, and loss of open space are just a few to mention. The most common way to lessen these impacts is through ***zoning***. Giving a section of land a complete evaluation as to what the most logical type of development would be for that section is of utmost importance. Most zoning categories fall under agricultural, commercial, residential, recreational, and industrial titles. If a section of land can have two or more uses at the same time it can be called ***multiple land-use*** zoning. For example national forests have been divided into the categories of wildlife preservation, recreation, lumbering, and watershed protection. This came about with the Multiple Use Sustained Yield Act in 1960.

Zoning is a way to protect the qualities of all types of land. As mentioned previously, once a land has been used for one purpose, due to the degradation, it is hard or almost impossible to use it for anything else. This is extremely important considering what our land gives us. It is an area with a thin covering of soil which consists of a mixture of water, living organisms, minerals, organic material, and air that supports all plant life.

The formation of soil begins by the breaking down of rocks into fragments through weathering and erosion. This is an extremely slow process due to the fact that the recycling of rocks is the slowest of all of Earth's cyclical processes. Organisms play an extremely important role in soil formation. They break down organic debris and deposit their own organic matter within their wastes. This layer is knows as humus. Humus is very important because it supplies nutrients needed by plants, it increases the acidity level needed for further breakdown, and it is very porous increasing the water-holding capacity which are all important for plant growth. The formation of soil is one of the many cyclical processes responsible for concentrating mineral resources on which humans depend. Entire civilizations have collapsed due to mismanaged soil practices needed to support their populations. Therefore, protecting our land, protects our soils, which protects ourselves.

Materials:

An Apple for each student

A knife for each student

Our Ecological Footprint by Mathis Wackernagel and William Rees

Transparencies:

Thought for the Day

The Rock Cycle (F-31 & F-32)

Soil Ecology (F-18 this was used in Week 2)

Poster: In the time it took to form one inch of soil (if available)

Procedure:

1) Demonstrate the importance of protecting our land resource.
    a) Pass out an apple and a knife to every student.
    b) The apple represents the earth. Slice the apple into four quarters, setting aside three. The three-quarters represent the oceans and the one-quarter represents the earth's land area (1/4).
    c) Slice this land area in half. Set aside one piece, which represents the land area that is inhospitable to people, such as polar areas, deserts, swamps, or high rocky mountains. The remaining piece (1/8) is land area where people live, but not necessarily where they grow food, such as houses, highways, parking lots, schools, etc.
    d) Slice this piece into four pieces. Set three aside (3/32), this represents the areas too wet, cold, rocky, or steep where the soil is too poor to produce food.
    e) Carefully peel the 1/32 slice of earth left. This represents the very thin surface of the earth's crust that we depend on for food production.
    f) Eat the unusable parts of the earth and collect the knives.
    g) Discuss the importance of protecting the 1/32 part of the earth in which we need to survive.
2) Discuss land-use planning and ecological land-use planning.

        -How are they different?

        -What pressures are involved with each?

-How has urban sprawl increased the need for ecological land-use planning?

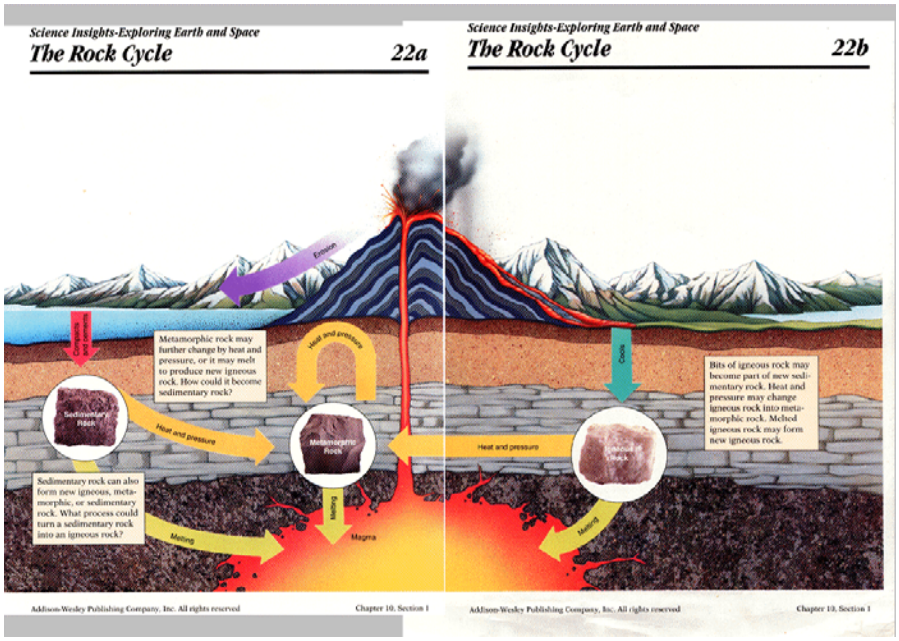
-Where does zoning come in?

-How can multiple land-use zoning be beneficial?

-Why is ecological land-use planning extremely important for our soil?

3) Discuss the slowest cyclical earth process of soil development.

-Use the transparency ***The Rock Cycle***, F-31 & F-32 to explain where weathering and erosion take place for the beginning step of fragmentation for soil development.



Figures 31 and 32: The Rock Cycle

From *Science Insights: Exploring Earth and Space* © by Addison-Wesley Publishing Company, Inc. Used by permission.

-Discuss the interactions of organisms within organic debris in the development of soil.

-Show the transparency ***Soil Ecology***, F-18 (used in Week 2, no picture shown) while discussing the importance of soil to all other cycles within nature.

4) Connect the extremely slow development of soil back to the importance of ecological land-use planning. Use the poster ***In the time it took to form one inch of soil . . .*** as a visual.

5) Have the students connect what they have just learned about soil to the paper they wrote for week two about their encapsulated city (refer to page 29 of *Our Ecological Footprint* if needed).

-Did they take the development of soil into account when writing their paper?

-How and what would they change knowing what they now know about soil?

6) Relate land-use to *Our Ecological Footprint*.

Key Statements for Discussion:

Location	Statement
Page 62	High-input production agriculture typically depletes cropland soils in North America 10 to 20 times faster than they can regenerate.

In other words, to compensate for soil loss, land in crop production should be left fallow for a decade or more for each year of cultivation.

Page 91

If the present world population requires at least 9.6 billion hectares to sustain its activities, a five-to ten-fold increase would correspond to a total productive land requirement of 48 to 96 billion hectares. Thus, to accommodate *sustainably* the anticipated increase in population and economic output of the next four decades we would need six to twelve additional planets.

Assignment:

Reading:

Chapters 4-7 of *The Ecology of Commerce* by Paul Hawken

Week Eight

CONSUMPTION/FOOTPRINT

Thoughts for the Day (Amazing Eco-Facts and Figures):

-Two U.S. children have as much impact on earth as 100-200 children in a Lower Developed Country (LDC).

-Enough grain is squandered every day in raising American livestock for meat to provide every human being on earth with two loaves of bread.

-If everyone in the U.S. recycled their newspapers, including the comics, we would save 500,000 trees every week.

Purpose:

To explain how our daily decisions to consume are affecting our environmental outlook for the future.

Objectives:

1) To describe how our energy consumption is increasing and what affects it is having on our environment.
2) To explain how our product consumption is increasing and what affects it is having on our environment.

Background Information:

Vocabulary:

LDC- lesser developed country

Affluence- having wealth and riches

Fair Earthshare- the amount of ecologically productive land available per person on Earth.

The history of energy consumption has changed greatly from the early civilizations burning wood to the current industrialized societies use of fossil fuels. Historically, goods were produced on small scale in the home, until the manufacturing processes became easier due to fossil fuel energy use. The creation of factories brought homes closer together ultimately creating cities. The wide spread ease of the use of fossil fuels is directly linked to economic growth. Although economic growth is seen as a good thing, it only increases energy consumption as well as product consumption. These industrialized societies have energy consumptions eight times that of ***LDCs***. We (industrialized countries) tend to want things not realizing the energy required to deliver these products to us. For example, Florida oranges, Texas beef, and Hawaiian pineapples do not magically appear in all parts of the world, yet we expect to have them at our request. It is evident that the amount of energy used is directly related to the complexity of the civilization, i.e. ***affluence***.

Affluence combined with population growth and wasteful practices is the leading threat to most forests throughout the world. Not only are there more people using products, but our consumption of products per capita is increasing. This need for more is hardly explainable, but after knowing the impact we are causing maybe it can be changed.

Mathis Wackernagel and William Rees have come up with a way to measure consumption. They call it our ecological footprint. It can be measured for the world,

individual countries, individual populations, or even just the individual. This is based on the idea that for every product consumption or energy consumption, a certain amount of "land" is required to provide the resource flows and waste sinks. The calculations require detailed monitoring of all activities everyday for a long period of time (they suggest a full year). This monitoring is broken up into five consumption categories; food, housing, transportation, consumer goods, and services. Once these amounts have been measured they are broken up into a land use matrix for specific breakdowns of types of land. All in all the total number at the end indicates the amount of "land" needed to sustain the population or individual studied at the current rate of consumption. Given the current population of the earth we need not take more than our ***fair Earthshare***.

Materials:

Transparency:

Thought for the Day

Our Ecological Footprint by Mathis Wackernagel and William Rees

The Ecology of Commerce by Paul Hawkin

Video: *Affluenza*

TV/VCR

Procedure:

1) Discuss the history of consumption.

-How did the use of fossil fuels increase growth?

-What environmental concerns come with growth?

-Why do you think most people believe more is better?

2) Discuss our ecological footprint.

    -Do you believe this is a realistic measurement?

    -Do people have the right to take more than their fair Earthshare?

    -Do you believe affluence is truly a cause of overconsumption?

3) Show the video *Affluenza*.

    -Is this movie realistic?

    -Do you see our society in this state?

4) Relate consumption to *Our Ecological Footprint*.

    Key Statements for Discussion:

Location	Statement
Page 4	Sustainability requires that our emphasis shift from "managing resources" to managing *ourselves*, that we learn to live as part of nature. Economics at last becomes human ecology.
Page13	Indeed, if everyone on Earth lived like the average Canadian or American, we would need at least three such planets to live sustainably.
Page 47	. . . natural capital is a prerequisite for human-made goods, while the opposite is not the case.

Page 67	Discuss Figure 3.1
Page 81	Note that while U.S. consumption patterns are roughly similar to Canada's *per capita* totals, their (U.S.) average Ecological Footprints are larger. (Refer to tables on pages 82 and 85.)
Page 90	Humanity's Ecological footprint is as much as 30 percent larger than nature can sustain in the long run.

5) Relate consumption to *The Ecology of Commerce*.

Key Statements for Discussion:

Location	Statement
Page 3	. . . we are all here together, at once, at the service of and at the mercy of nature, each other, and our daily acts.
Page 5	What is the logic of extracting diminishing resources in order to create capital to finance more consumption and demand on those same diminishing resources? How do we imagine our future when our commercial systems conflict with everything nature teaches us?

Assignment:

Reading:

Read chapters 8-10 of *The Ecology of Commerce*

Recording:

Track your "consumptions" for the week. Include the following:

Grocery bills

Energy (refer to last electric bill divide by 4 for 1 weeks worth)

Garbage accumulation (weight)

Recycled mass

Water usage (refer to last bill and divide by 4)

Shopping (clothes, lawn equipment, etc.)

Make notes of all these things and bring them to class next week.

Week Nine

ESCAPE FROM AFFLUENZA

Thoughts for the Day (Amazing Eco-Facts and Figures):

-Each American produces about four pounds of garbage each day.

-Americans own 1/3 of all the world's cars and drive about as many miles as the rest of the world combined.

Purpose:

To explain how the change in society's consumerism has to start with the individual.

Objectives:

1) To describe ways one can decrease their energy consumption.
2) To describe ways one can decrease their product consumption.

Background Information:

Refer to Week Eight Consumption/Footprint lesson if needed.

Materials:

Transparencies:

Thought for the Day

Affluenza (F-33)

Our Ecological Footprint by Mathis Wackernagel and William Rees

The Ecology of Commerce by Paul Hawken

Video: *Escape from Affluenza*

TV/VCR

Procedure:

1) Place the transparency ***Affluenza***, F-33 on the overhead while discussing personal consumptions from the past week.

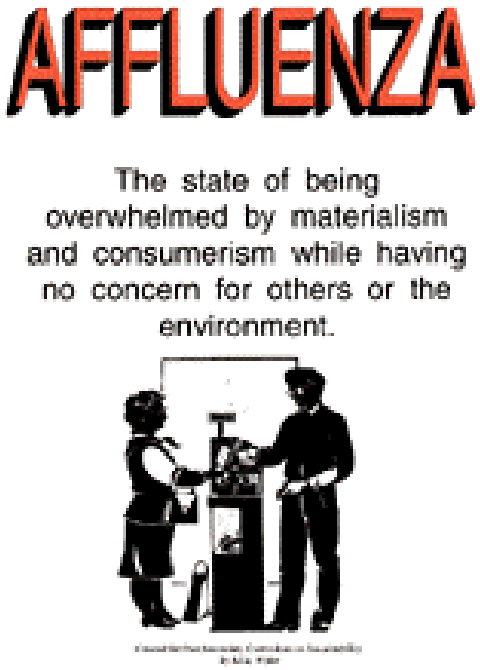


Figure 33: Affluenza

-groceries

-energy used

-garbage accumulated

-recycled mass

-water usage

-shopping

Discussion Questions:

-How do different class members compare with each other?

-Did knowing you had to write down all of your consumptions have any affect on usages?

-Did your recycling increase?

3) Show the video *Escape from Affluenza*.

-Do you feel this video is realistic?

-Would you be willing to do some of these things for your environment?

-Do you feel you could talk a friend into doing these things?

-Who would be the hardest person in your life to convince that they should be doing these things? Why?

-What would you do to change their mind?

4) Relate *Escape from Affluenza* to *Our Ecological Footprint*.

Key Statements for Discussion.

Location	Statement
Page xi	The first step toward reducing our ecological impact is to recognize that the "environmental crisis" is less an environmental and technical problem than it is a behavioral and social one. It can therefore be resolved only with the help of behavioral and social solutions.

Page 21	Ecological Footprint analysis is not against trade per se. However, it examines trade through an ecological lens and reveals its environmental consequences.

5) Relate *Escape from Affluenza* to *The Ecology of Commerce*.

Key Statements for Discussion:

Location	Statement
Page 3	We know that every natural system on the planet is disintegrating. The land, water, air, and sea have been functionally transformed from life-supporting systems into repositories for waste.
Page 9	. . . most people involved with commerce who are also educated about the environmental issues care deeply about commerce's effect.
Page 14	We create businesses just as much as businesses create our wants.

Assignment:

Reading:

Finish *The Ecology of Commerce*

Project:

Begin working on Video project. You are to create your own “Escape from Affluenza” video.

Guidelines:

-It must be 10 to 12 minutes in length.

-It may include your entire household or just you personally.

-It must have logical solutions as to how you are going to “take” less from the environment.

-Be creative.

These are due at the beginning of class of week 14. Extra credit will be given to anyone that turns them in early so we can begin watching them as they come in.

Study for Exam Two.

Week Ten

VIDEO PRESENTATIONS/

SUSTAINABILITY: EXAM 2

Thoughts for the Day (Amazing Eco-Facts and Figures):

-If you lined up all the styrofoam cups made in just one day, they would circle the Earth and go a little further.

Materials: Transparency (optional)

Video Presentations:

Watch any video that was turned in early. Discuss.

Exam:

The exam consist of fifty questions. Thirty multiple-choice, fifteen true/false, and five essay/short answer. Allow at least two hours if all questions are used.

Answer Key:

1) D	11) B	21) C	31) F	41) F
2) B	12) D	22) D	32) T	42) T
3) A	13) A	23) D	33) F	43) T
4) D	14) C	24) D	34) F	44) F
5) B	15) D	25) B	35) F	45) T
6) D	16) B	26) A	36) T	
7) A	17) A	27) C	37) T	
8) C	18) D	28) D	38) F	
9) C	19) A	29) B	39) T	
10) A	20) C	30) A	40) T	

46-50) Answers will vary based on opinions.

Name _____ Instructor _____ Section _____

SUSTAINABILITY: EXAM 2

MULTIPLE CHOICE: Choose the appropriate letter that best answers the question.

1) Each American produces about _____ pounds of garbage each _____.
    a) 10, day
    b) 20, month
    c) 12, month
    d) 4, day
2) Planning which considers all aspects including geological, ecological, economic, health, and social factors is called
    a) land-use planning
    b) ecological land-use planning
    c) zoning
    d) regulating
3) Regulation that allows more than one use of the land at the same time is called
    a) multiple land-use
    b) ecological land-use
    c) ecological regulation
    d) multiple regulation of land

4) Unplanned growth in suburban areas is called

    a) suburban webbing

    b) urban webbing

    c) economic sprawl

    d) urban sprawl

5) Currently in the United States about _____ of land is used for crops and livestock.

    a) 33%

    b) 47%

    c) 65%

    d) 83%

6) Currently in the United States about _____ of land is used intensively by people in urban centers and as transportation corridors.

    a) 75%

    b) 50%

    c) 23%

    d) 5%

7) A thin covering of _____ consists of a mixture of water, living organisms, minerals, organic material, and air that supports all plant life.

    a) soil

    b) rocks

    c) bedrock

    d) grass

8) The slowest cyclical process on earth is the

   a) nitrogen cycle

   b) oxygen cycle

   c) rock cycle

   d) carbon cycle

9) Two U.S. children have as much impact on earth as _____ children in an LDC.

   a) 25-50

   b) 50-100

   c) 100-200

   d) 200-300

10) One of the major contributors to a country's increased energy use is

   a) affluence

   b) level of education

   c) population

   d) knowledge of environmental concerns

11) The way to measure consumption devised by Mathis Wackernagel and William Rees is our

   a) ecological impact

   b) ecological footprint

   c) ecological output

   d) ecological situation

12) The amount of ecologically productive land available per person on Earth is our

a) fair share

b) fair proportion

c) respectable piece

d) fair Earthshare

13) Once a land has been used for one purpose it

a) is almost impossible to use it for anything else

b) must remain barren for 20 years

c) can never be used for any other purpose

d) must become a parking lot

14) Most of the national forests are located where?

a) central United States

b) southeastern United States

c) western United States

d) northeastern United States

15) In the rock cycle igneous rocks

a) come to the surface to go through weathering and erosion

b) sink down deep within the earth to become metamorphic rocks

c) melt again and become a different igneous rock

d) all of the above

16) Land should be considered a

a) renewable resource

b) nonrenewable resource

c) reusable resource

d) nonreusable resource

17) The Multiple Use Sustained Yield Act of 1960

a) promoted multiple land-use zoning

b) required specific zoning of land

c) required agricultural land areas

d) promoted urban zoning

18) According to *Our Ecological Footprint*, humanity's ecological footprint is as much as _____ larger than nature can sustain in the long run.

a) 50%

b) 70%

c) 10%

d) 30%

19) High-input production agriculture typically depletes cropland soils in North America _____ times faster than they can regenerate.

a) 10 to 20

b) 20 to 30

c) 30 to 40

d) 40 to 50

20) Given the situation in question 19, land in crop production should be left fallow for _____ for each year of cultivation.

a) two years

b) five years

c) a decade

d) twelve years

21) If everyone in the U.S. recycled their newspapers, we would save

a) 20,000 trees every week

b) 100,000 trees every week

c) 500,000 trees every week

d) 1,000,000 trees every week

22) In calculating an ecological footprint, monitoring is broken up into _____ consumption categories.

a) 10

b) 3

c) 7

d) 5

23) All of the following are consumption categories for an ecological footprint calculation except

a) food

b) transportation

c) services

d) donations

24) The ecological footprint can be used to measure impact by

a) individuals

b) communities

c) countries

d) all of the above

25) According to *Our Ecological Footprint*, sustainability requires that our emphasis shift from managing resources to managing

a) economics

b) ourselves

c) productions

d) consumptions

26) The footprint of the United States is most similar to that of

a) Canada

b) China

c) India

d) Australia

27) The recommended length of tracking for a true measure of an ecological footprint is

a) a week

b) a month

c) a year

d) five years

28) Unplanned urban sprawl causes

a) transportation problems

b) loss of farmland

c) floodplain problems

d) all of the above

29) All of the following are true of humus soil except

a) it supplies nutrients needed by plants

b) organisms cannot live there due to acidity levels

c) it increases acidity levels needed for breakdown

d) it is porous increasing water-holding capacity for plant growth

30) In the class demonstration for available land, the first cut was to divide the apple in fourths, ¾ represented _____ and ¼ represented _____.

a) oceans, land

b) icecaps, land

c) land, oceans

d) land, icecaps

TRUE/FALSE: Answer the following statements as true or false by circling the appropriate response.

T F 31) The hydrologic cycle is the slowest cycle on Earth.

T F 32) LDC's are Lesser Developed Countries.

T F 33) Ecological land-use planning is based on population and economic development.

T F 34) Crops and livestock take up 30% of U.S. land.

T F 35) Multiple land-use zoning requires at least three uses of the designated land.

T F 36) Thousands of organisms live in humus soil.

T F 37) Most national forests are in the western U.S.

T F 38) The United States ecological footprint is most similar to Europe.

T F 39) The amount of energy used is directly related to the complexity of the civilization.

T F 40) Food, housing, and services are three consumption categories within the ecological footprint calculation.

T F 41) The Multiple Use-Sustained Yield Act of 1960 pertained only to national forest.

T F 42) There are more shopping malls than high schools in the U.S.

T F 43) Unplanned growth in suburban areas is urban sprawl.

T F 44) Considering economics and growth is enough for ecological land-use planning.

T F 45) Zoning is a way to protect the qualities of all types of land.

ESSAY/SHORT ANSWER: Write complete sentences to answer the following questions. Remember to support your answers. You may use extra paper if needed.

46) Explain how weathering and erosion can be a positive thing ecologically.

47) Do you believe the video *Affluenza* realistically reflects our society. Why or why not?

48) Is escaping from consumerism possible? Why or why not? How?

49) Do you believe living a more simple life (decreasing consumerism) will decrease your quality of life? Why or why not?

50) What do you believe is the biggest obstacle facing us towards becoming a sustainable planet?

Week Eleven

QUALITY OF LIFE

Thought for the Day (Amazing Eco-Facts and Figures):

One billion people around the globe are surviving on less than $400 each year.

Purpose:

To explain that having a quality life is based on having the necessities to survive.

Objectives:

1) To define quality of life and list basic necessities to achieve it.
2) To explain that the essential elements of a quality life are universal worldwide.
3) To define physical quality of life and use its index to rank countries according to their quality of life.

Background Information:

There are several basic needs that every human must have to survive. Food, shelter, and a sense of wellbeing are probably the three most undisputed necessities. Everything else in life should be considered a luxury. These needs are universal and if you were to ask a more-developed country their list of basic needs it should be the same as if you were to ask a lesser-developed country. These basic needs are pretty self-explanatory, but here is a description of what is meant by each. Food means that everyone must have the required nutrients to lead a healthy life, shelter requires that one have protection from the elements in nature, and lastly a sense of well-being means that one must be of sound mind and body to withstand any other pressures of the world.

The Physical Quality of Life Index developed by the Overseas Development Council is a composite measure of human wellbeing based on social indicators. Life expectancy, infant mortality rate, and literacy rate are just a few ways to objectively determine a country's wellbeing. Other indicators such as GNP and calorie intake are looked at, but carry less weight due to the fact that total agreement cannot be made on a specific standard.

Materials:

Handout 12: Physical Quality of Life (one for each student)

Transparencies:

Thought for the Day

Farside cartoon Rory the Racoon (F-34)

Handout 12 Physical Quality of Life (F-35)

Physical Quality of Life Answer Key (F-36)

Computer Lab with Internet access for at least an hour

Our Ecological Footprint by Mathis Wackernagel and William Rees

The Ecology of Commerce by Paul Hawken

Procedure:

1) Place the ***Farside cartoon Rory the Racoon***, F-34 on the overhead and talk about quality of life in regards to a sense of wellbeing.

The Far Side by Gary Larson

Figure 34: Rory the Racoon THE FAR SIDE © FARWORKS, INC. Used by permission of UNIVERSAL PRESS SYNDICATE. All rights reserved.

2) Discuss what is quality of life. Poll the students as to what necessities one must have to survive.

-What are the basic needs of all human beings?

-What resources are necessary to provide for those needs?

-What additional things do you consider necessary in order to live a comfortable and fulfilling lifestyle?

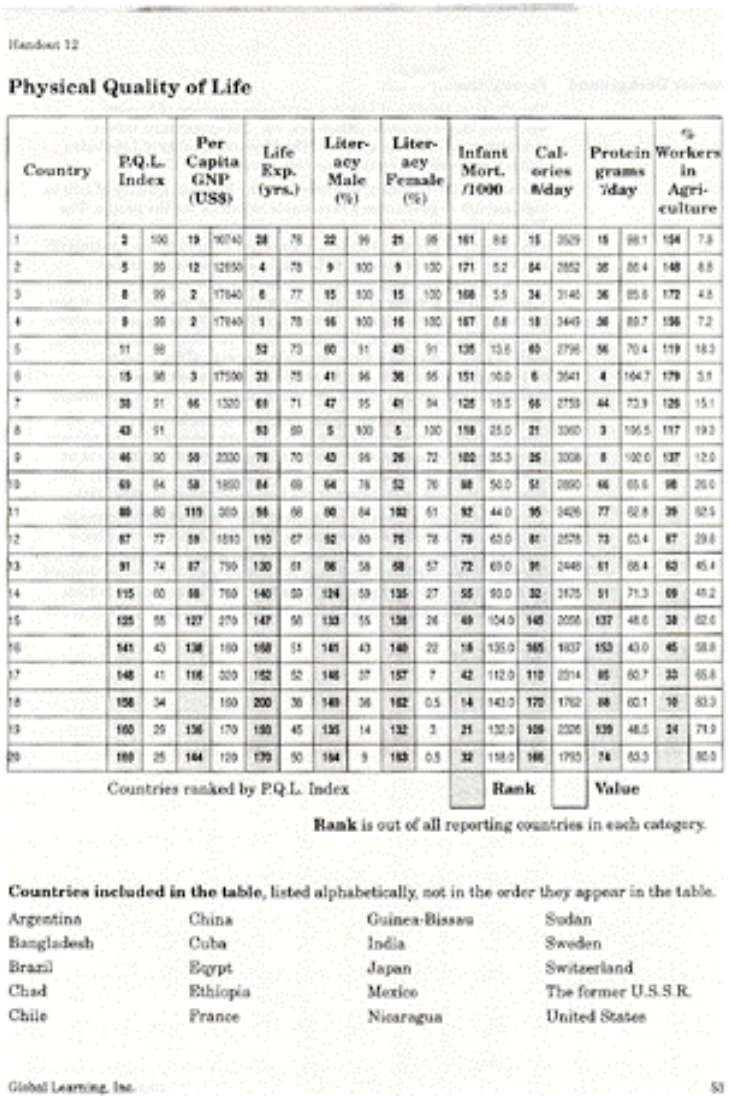
-What environmental impacts are associated with maintaining a

comfortable and fulfilling lifestyle?

-Would lowering your impacts reduce your quality of life?

-Do you believe our quality of life in the United States is equal to the quality of life in other countries?

3) Discuss the Physical Quality of Life Index. Pass out Handout 12.



Handout 12

Physical Quality of Life

Country	P.Q.L. Index		Per Capita GNP (US$)		Life Exp. (yrs.)		Literacy Male (%)		Literacy Female (%)		Infant Mort. /1000		Calories #/day		Protein grams 7/day		% Workers in Agriculture	
1	2	100	19	16740	28	78	22	99	21	99	161	9.6	15	3529	15	98.1	104	7.8
2	5	99	12	12650	4	75	9	100	9	100	171	5.2	84	2852	35	86.4	148	8.8
3	8	99	2	17640	6	77	15	100	15	100	168	3.9	34	3146	36	85.6	172	4.8
4	9	99	2	17640	1	78	16	100	16	100	167	0.8	18	3440	38	89.7	156	7.2
5	51	98			52	73	60	91	49	91	135	13.6	60	2796	56	70.4	119	18.3
6	15	98	3	17500	33	75	41	96	36	95	151	10.0	6	3641	4	104.7	179	5.1
7	38	91	66	1320	69	71	47	95	41	94	125	10.5	66	2759	44	73.9	126	15.1
8	43	91			93	69	5	100	5	100	158	25.0	21	3060	3	106.5	117	19.3
9	46	90	58	2030	78	70	43	96	26	72	102	35.3	26	3008	8	100.0	137	12.0
10	69	84	58	1850	84	69	64	78	52	76	88	50.0	51	2890	66	65.6	98	26.0
11	80	80	119	300	96	66	60	64	102	61	92	44.0	95	2426	77	62.8	39	62.5
12	87	77	59	1810	110	67	92	60	75	78	79	63.0	81	2578	73	63.4	87	29.8
13	91	74	87	799	130	61	96	58	68	57	72	69.0	91	2446	61	68.4	62	45.4
14	115	60	88	760	140	59	124	59	135	27	55	90.0	32	2675	51	71.3	69	49.2
15	125	55	127	270	147	50	133	55	138	26	49	104.9	148	2056	137	48.6	38	62.6
16	141	43	138	160	158	51	141	43	140	22	18	135.9	165	1937	153	43.0	45	58.8
17	148	41	116	320	152	52	148	37	157	7	42	112.0	110	2314	85	60.7	33	65.8
18	156	34		160	200	36	149	36	162	0.5	14	143.0	170	1762	88	60.1	10	83.3
19	160	29	136	170	160	45	135	14	132	3	21	132.0	109	2326	130	46.5	24	71.9
20	169	25	144	120	170	50	164	9	163	0.5	32	118.0	166	1765	74	63.3		80.0

Countries ranked by P.Q.L. Index — Rank — Value

Rank is out of all reporting countries in each category.

Countries included in the table, listed alphabetically, not in the order they appear in the table.

Argentina	China	Guinea-Bissau	Sudan
Bangladesh	Cuba	India	Sweden
Brazil	Egypt	Japan	Switzerland
Chad	Ethiopia	Mexico	The former U.S.S.R.
Chile	France	Nicaragua	United States

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Figure 35: Physical Quality of Life

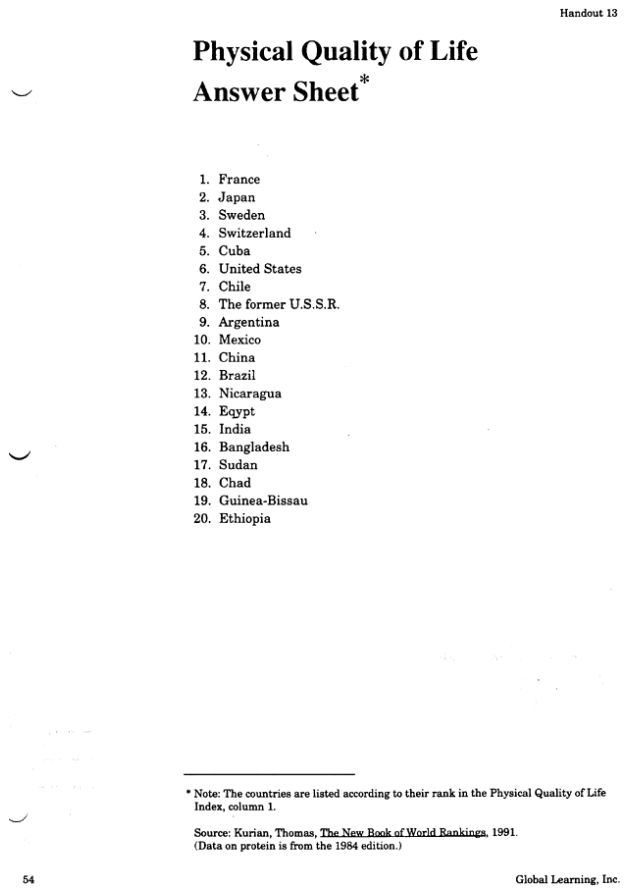
From Global Learning Inc.

Go through each category and discuss its meaning. Explain that the P.Q.L. Index is determined by averaging life expectancy, infant mortality rate, and literacy rate when each are based on a scale of 1 to 100 with 100 at the top and 1 at the bottom.

-Why might those three categories be used verses others?

-Is per capita GNP a good measure of a quality life? Why?

4) Divide the class into groups and have them research, on the internet, the information given in the table. Their task is to place the appropriate country by its correct information. *Warn students that the numbers might not be exact, but should be fairly close. Give them 45 minutes to an hour to research.
5) Pull the class back together and go over their results. Use the transparency from Handout 12 to fill in together.



Handout 13

Physical Quality of Life
Answer Sheet*

1. France
2. Japan
3. Sweden
4. Switzerland
5. Cuba
6. United States
7. Chile
8. The former U.S.S.R.
9. Argentina
10. Mexico
11. China
12. Brazil
13. Nicaragua
14. Egypt
15. India
16. Bangladesh
17. Sudan
18. Chad
19. Guinea-Bissau
20. Ethiopia

* Note: The countries are listed according to their rank in the Physical Quality of Life Index, column 1.

Source: Kurian, Thomas, The New Book of World Rankings, 1991.
(Data on protein is from the 1984 edition.)

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Figure 36: Physical Quality of Life Answer Sheet

From Global Learning Inc.

-Is there a relationship between economic development and a high quality of life?

-Is a high quality of life essential for economic development?

-What equity issues emerge as you analyze these data?

-How could a comfortable and fulfilling lifestyle be provided for all of the world's people?

-What are some of the potential consequences of continued and increasing

inequity between individuals and nations?

6) Relate Quality of Life to Our Ecological Footprint.

Key Statements for Discussion:

Location	Statement
Page 1	. . . increasing economic production has neither leveled income differences, made the "haves" noticeably happier, nor satisfied the basic needs of the world's poorest one billion people. While 20 percent of the world's population enjoys unprecedented material well-being, at least another 20 percent remain in conditions of absolute poverty.
Page 22	Modern intensive production methods not only accelerate the depletion and contamination of field and forest, but the economic benefits of the increased productivity are inequitably distributed, particularly in low-income countries.
Page 32	For the first time, environment and equity became explicit factors in the development equation.

Page 33	. . . “development” as the realization of fuller and greater potential. In short, growth means getting bigger while development means getting better. . . . Developing sustainability may actually require a *reduction* in aggregate economic throughput, while enabling the poor to consume *more*.
Page 104	. . . condominium dwellers may see an improvement in their quality of life - - they may be able to walk to work, be closer to friends and relatives, enjoy a more vital neighborhood, and take advantage of greater recreational diversity such as parks, pedestrian areas, street cafes, movie theatres, and more.
Page 134	In economic terms, the minimal goal would be for everyone to be able to attain a material standard sufficient for them to enjoy an emotionally and spiritually satisfying life.

Page 136	It turns out that the best things in life are not "things." In fact, having fewer possessions does not need to deprive us, but can be liberating. True fulfillment comes from being with others and contributing to their lives, rather than from taking and withdrawing.

7) Relate Quality of Life to *The Ecology of Commerce*

Key Statements for Discussion:

Location	Statement
Page 2	We have the capacity and ability to create a remarkably different economy, one that can restore ecosystems and protect the environment while bringing forth innovation, prosperity, meaningful work, and true security.
Page 5	But now, rather than distributing the wealth of the present, we are stealing the wealth of the future to enrich a society that seems nonetheless deeply troubled about its "good fortune."

Assignment:

Project:

Continue working on video project.

Reading:

Read Chapters 1-4 of *Environmental Ethics Duties to and Values in the Natural World* by Holms Rolston, III

Week Twelve

ETHICS VERSES VALUES

Thought for the Day (Amazing Eco-Facts and Figures):

Every Week, about 20 plant and animal species become extinct.

Purpose:

To distinguish between ethics and values and give bases for each.

Objectives:

1) To define the three theories of environmental responsibility.
2) To define the three environmental ethic approaches.
3) To define values and discuss cultural differences in values.

Background Information:

Vocabulary:

Ethic-fundamentally what is right and what is wrong.

Anthropocentric-human-centered theory that believes all environmental responsibility is derived from human interests alone

Biocentric-life-centered theory in that all forms of life have an inherent right to exist.

Ecocentric-theory believes the environment deserves direct moral consideration.

Morals-what is believed to be right or wrong reflected by a culture

Values-what one places as desirable

In environmental ***ethics***, there are three basic viewpoints; ***anthropocentric***, ***biocentric***, and ***ecocentric***. These views have verying degrees of responsibility towards the environment. An anthropocentric ethic involves assuring that the earth remains a hospitable place for supporting human life, and that its resources are preserved so that humans can continue to live in comfort. The biocentric ethic is one that bestows all forms of *life* the inherent right to exist, while an ecocentric ethic awards the entire environment moral consideration. For one to support the idea of sustainability, and believe that we (humans) are part of nature, an ecocentric view must be taken. Therefore, the well-being of the individual and of each species is tied to the well-being of the whole planet.

Along with the environmental viewpoints, there are also different environmental attitudes. These attitudes reflect a code of conduct within nature that is somewhat similar to the viewpoints. For example the first attitude is based on the development ethic which is believed by an anthropocentric. One with this attitude feels that humans should build, build, build. Creating continual change is viewed as progress. Bigger, better, and faster is their motto, and nature is thought to only be here for humans to utilize. The second attitude is the preservation ethic. Someone with this attitude holds the viewpoint of a biocentric. They believe that nature has intrinsic value or inherent worth. These feelings are based on many different reasons ranging from religious to scientific justifications. Lastly, the conservation ethic, believed by ecocentrics, is similar to the preservation ethic except that it includes the entire earth. "The conservation ethic stresses a balance between total development and absolute preservation. It stresses that rapid growth and uncontrolled growth in population and economics is self-defeating in the long run. The

goal of the conservation ethic is one people living together in one world, indefinitely (Enger 2000).” This is the ideal sustainability belief.

As mentioned before, an ethic is what is known to be right or wrong. Morals are what is believed as right or wrong based on a particular culture. Different cultures have belief systems that are reflected within their morals. What one culture believes as morally correct is not necessarily what others believe. These beliefs are based on what that particular culture places value on. Who is to say which culture is right and what grounds do you base these decisions? Placing value on particular things has become somewhat controversial between cultures. The bases for applying value have no cross-cultural standard therefore, it is easy to criticize when one does not belong to that culture. A good example of the different cultural views on values verses an ethic is present today in India. The Hindu religion believes that the cow is a sacred animal and therefore should not be eaten. They have placed “value” in the cow, in spite of thousands starving in India everyday. Ethics would tell you that no one deserves to starve, that is “wrong”, yet the *morals* of the Hindus tell them otherwise.

There will never be a consistent set of morals (values) for the entire planet, but if we as a human race desire to be ethical people, we might have a chance of becoming sustainable.

Materials:

Transparencies:

Thought for the Day

Farside cartoon of the Hunted Bear (F-37)

Where is the Conflict Between Ethics and Values? (F-38)

Values and Economic Development (F-39)

An Interpretation of the Value Statements (F-40)

Sources of Value Statements (F-41)

Handouts:

Values and Economic Development

An Interpretation of the Value Statements

Our Ecological Footprint by Mathis Wacckernagel and William Rees

The Ecology of Commerce by Paul Hawken

Environmental Ethics by Holmes Rolston, III

Procedure:

1) Begin by placing the Farside transparency of the bear on the overhead. Discuss how society portrays nature in this picture.

The Far Side by Gary Larson

Figure 37: Hunted Bear THE FAR SIDE © FARWORKS, INC. Used by permission of UNIVERSAL PRESS SYNDICATE. All rights reserved.

-Was it ethical for this man to shoot the bear simply to have it stuffed?

-Is it ethical to portray the bear as a vicious beast?

2) Discuss the perspectives presented within this lesson.

-anthropocentric

-biocentric

-ecocentric

-development ethic

-preservation ethic

-conservation ethic

Explain that the conservation ethic is the approach we will have to have to succeed at becoming a sustainable planet.

3) Discuss the difference between an ethic and a moral. Emphasize that they are very similar, but morals reflect cultural values.

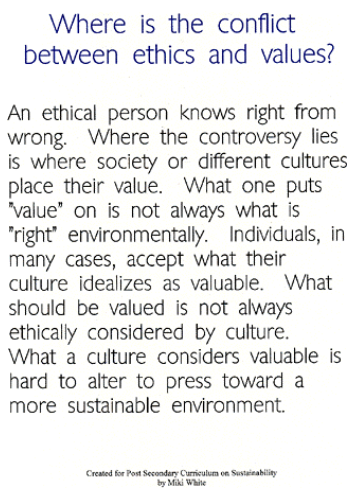
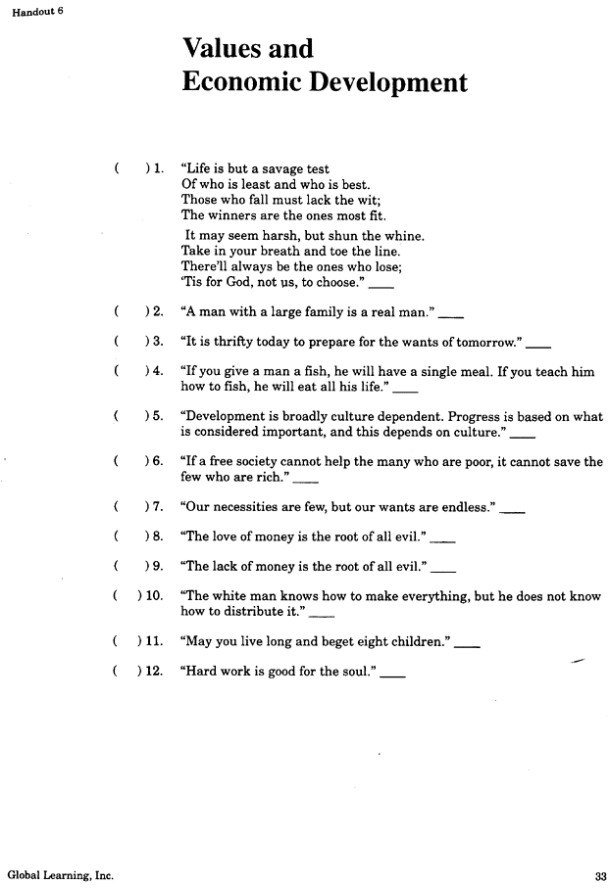


Figure 38: Where is the conflict between ethics and values?

-How can one determine who is morally correct?

4) Pass out the Handout Values and Economic Development and read through them aloud. Discuss. Pass out the handout an Interpretation of the Value Statements and direct the students to match the interpretations to the statements. Allow time for students to complete. Discuss their decisions and reasons why. Place the transparency ***Sources of Value Statements*** on the overhead and compare with the students results. Have the students write the correct match in the parentheses in front of each statement. Discuss.



Handout 6

Values and Economic Development

( ) 1. "Life is but a savage test
Of who is least and who is best.
Those who fall must lack the wit;
The winners are the ones most fit.
It may seem harsh, but shun the whine.
Take in your breath and toe the line.
There'll always be the ones who lose;
'Tis for God, not us, to choose." ___

( ) 2. "A man with a large family is a real man." ___

( ) 3. "It is thrifty today to prepare for the wants of tomorrow." ___

( ) 4. "If you give a man a fish, he will have a single meal. If you teach him how to fish, he will eat all his life." ___

( ) 5. "Development is broadly culture dependent. Progress is based on what is considered important, and this depends on culture." ___

( ) 6. "If a free society cannot help the many who are poor, it cannot save the few who are rich." ___

( ) 7. "Our necessities are few, but our wants are endless." ___

( ) 8. "The love of money is the root of all evil." ___

( ) 9. "The lack of money is the root of all evil." ___

( ) 10. "The white man knows how to make everything, but he does not know how to distribute it." ___

( ) 11. "May you live long and beget eight children." ___

( ) 12. "Hard work is good for the soul." ___

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Figure 39: Values and Economic Development from Global Learning Inc.

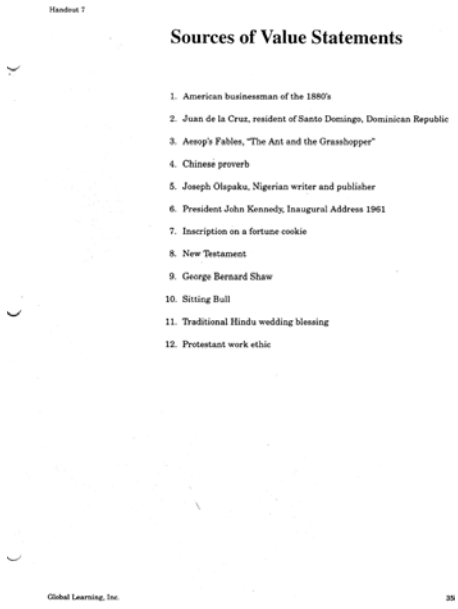
Handout 6

An Interpretation of the Value Statements

Directions Below are interpretations of the statements from the previous page. Match the interpretations below with the statements on the previous page by writing the letter of the interpretation in the blank space at the end of each statement.

a. This person believes that preparing a person to take care of himself/herself is more important than simply feeding the hungry.
b. Having many children is a sign of being a man. A person who believes this would not favor any attempts to limit population.
c. This statement implies that a person should have many children.
d. We should prepare today for the needs of tomorrow. This person plans for the future.
e. This statement implies that hard work is good for a person.
f. A culture will emphasize those things that are important to its culture.
g. This statement implies an obligation by the rich to help the poor.
h. This is a statement of survival of the fittest. It implies that God chooses those who are worthy. A person who believes this would feel that some people would not develop because they were not worthy.
i. This statement implies that seeking material wealth is the cause of most of society's problems.
j. This statement implies that being poor is the cause of most of society's problems.
k. This statement implies that even though Europeans have solved the problem of production, there are still great disparities in wealth.
l. This statement implies that what we need to survive is small. It also implies that we want more material things than we need.

Figure 40: An Interpretation of the Value Statements from Global Learning Inc.



Handout 7

Sources of Value Statements

1. American businessman of the 1880's
2. Juan de la Cruz, resident of Santo Domingo, Dominican Republic
3. Aesop's Fables, "The Ant and the Grasshopper"
4. Chinese proverb
5. Joseph Olapaku, Nigerian writer and publisher
6. President John Kennedy, Inaugural Address 1961
7. Inscription on a fortune cookie
8. New Testament
9. George Bernard Shaw
10. Sitting Bull
11. Traditional Hindu wedding blessing
12. Protestant work ethic

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Figure 41: Sources of Value Statements From Global Learning Inc.

5) Relate Ethics Verses Values to *Our Ecological Footprint*.

Key Statements for Discussion:

Location	Statement
Page 38	. . . the most promising hope for maintaining both significant biodiversity and the experience of nature under our prevailing value system may well be ecologically enlightened human self-interest. Of course, should humankind shift to more ecocentric values, its own survival might be assured even more effectively.
Page 137	Pushing the supposed "moral superiority" of sustainability will not make it happen. In today's fragmented and competitive world, playing on people's moral duty and feelings of guilt produces only resentment, not long-lasting transformation. Sustainability will remain a hard sell until we can show that people have more to gain than to lose by changing their ways. Change flows from

necessity, hope, realizable aspirations and joy, not shame and blame.

6) Relate Ethics Verses Values to *The Ecology of Commerce*.

Key Statements for Discussion:

Location	Statement
Page 1	The promise of business is to increase the general well-being of humankind through service, a creative invention and ethical philosophy.
Page 2	Businesspeople must either dedicate themselves to transforming commerce to a restorative undertaking, or march society to the undertaker.
Page 8	Why do we hand business a blank check and exempt enterprise from the responsibility for maintaining social values?
Page 9	Similarly, when environmental issues are presented to businesspeople as one more cost and one more regulation, "doing the right thing" becomes burdensome and intrusive.

7) Relate Ethics Verses Values to *Environmental Ethics*.

Key Statements for Discussion:

Location	Statement
Page 110	According to the reigning paradigm, there is no value without an experiencing valuer, just as there are no thoughts without a thinker, no percepts without a perceiver, no deeds without a doer, no targets without an aimer. Valuing is felt preferring; value is the product of this process.
Page 117	A morally mature person will say, "I do not want to be the type of person who values everything by cost-benefit analysis, nor by a what's-the-pleasure-in-it-for-me-and-my-kind analysis. One admirable trait in persons is being able to appreciate things outside themselves.
Page153	It is not preservation of *species* that we wish but the preservation of *species in the system*. It is not merely *what* they are but *where* they are that we must value correctly.

Assignment:

Project:

Continue working on video project. These are due week 14.

Reading-

Chapters 5-7 of *Environmental Ethics Duties to and Values in The Natural World* by Holmes Rolston, III

Week Thirteen

RIGHTS

Thought for the Day (Amazing Eco-Facts and Figures):

-The United States has one of the highest adolescent pregnancy, birth and abortion rates among affluent countries.

Purpose:

To explain our environmental rights for developing a more sustainable planet.

Objectives:

1) To define right and how to apply rights to the environment.
2) To explain the importance of equity in developing a sustainable planet.
3) To explain how our environmental rights becomes our environmental duties.

Background Information:

Vocabulary:

Right-a moral or legal action or decision

Duty-a moral or legal obligation

Equity-fairness

Intergeneration equity-fairness among generations

Our environment as defined by Einstein is "everything that isn't me". Actually, to be more accurate he should have said everything *including* me. So when we are talking about *environmental* ***rights*** it is all encompassing; land, air, water, other species, and humans.

Our environmental rights should include three basic parts, environment, ***equity***, and development. Environment first. This means committing ourselves to conserving resources. Resources are defined as a source of supply or support which, once again, includes the *entire* environment; land, air, water, other species, and humans. Equity second. There must be an elimination of poverty, hunger, and human suffering for there to be fairness around the world. Equity involves the present and the future. Unborn generations are not present to speak for themselves, therefore that responsibility falls on us. ***Intergenerational equity*** is the ultimate goal in the long run. The United Nations proposes three basic principles of intergenerational equity:

1) Each generation is required to conserve the natural and cultural resource base, so that it does not unduly restrict the options of future generations.
2) Each generation is required to maintain the quality of the planet so that it is passed on in no worse condition that it was received.
3) Each generation should provide its members with equitable access to the legacy from past generations.

It is believed that if these three principles are followed, then equity is ensured. Development third. Development is often confused with growth, however they are completely different. Development is defined as a society's process of improving the quality of human lives in many areas, including: income and consumption levels; social, political, and economic institutions; and freedom of choice over decisions that affect people's lives. To incorporate the word "sustainable in front of development, one must

take into consideration the first two elements, environment and equity, in order to achieve the overall goal of sustainability.

After all, our environmental right now becomes our environmental ***duty***. In the Environmental Ethic it is stated that "everything is interconnected, and that nothing is ever destroyed, only recycled. But this law is curiously normative, implying that humans, in their valuing of nature, ought to follow nature. Doing so is often a matter of prudence, but perhaps value in nature also generates human duties toward it" (Holmes, 1988). We have the duty of preserving and conserving our environment because we have already established that it has value. Whether that value is to us or strictly intrinsic is not the concern. Just the establishing that it has value is enough. Creating a sustainable planet is no longer our right, it is our duty.

**The best background information will come from reading the *Environmental Ethic*.

Materials:

Transparencies:

Thought for the Day

Farside cartoon of the Pig on Trial (F-42)

Farside cartoon of the Swamp Thing (F-43)

Intergeneration Equity (F-44)

Sustainable Development (3 phases) by Global Learning, Inc. (F-45-47)

Handout:

Sustainable Development (one per student)

Ecological Footprint by Mathis Wackernagel and William Rees

The Ecology of Commerce by Paul Hawken

Environmental Ethic Duties to and Values in the Natural World by Holmes Rolston, III

Procedure:

1) Begin by showing the transparency of the ***Farside cartoon of the Pig on trial*** F-42). Discuss what rights we have towards endangered species.

The Far Side by Gary Larson

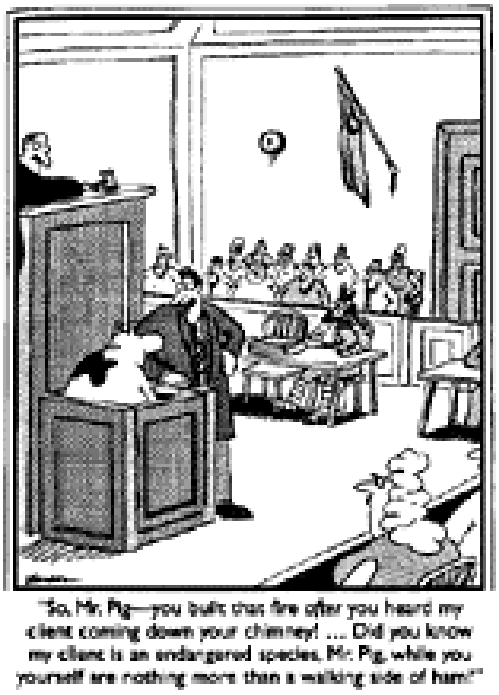


Figure 42: Pig on Trial THE FAR SIDE © FARWORKS, INC. Used by permission of UNIVERSAL PRESS SYNDACATE. All rights reserved.

2) Show the transparency of the ***Farside cartoon of the Swamp Thing*** (F-43). Discuss rights of environmental equity. Is being politically correct a way of treating others equally?

The Far Side by Gary Larson

Figure 43: Swamp Thing THE FAR SIDE © FARWORKS , INC. Used by permission of UNIVERSAL PRESS SYNDACATE. All rights reserved.

3) Discuss rights.

-What do all humans have rights of?

-What do all species have rights of?

-Are we responsible for maintaining these rights?

-Should it be an "every man for himself" mentality?

-When do rights become duties?

4) Discuss the United Nations Principles of Intergenerational Equity. Use the transparency ***Intergenerational Equity***, F-44.

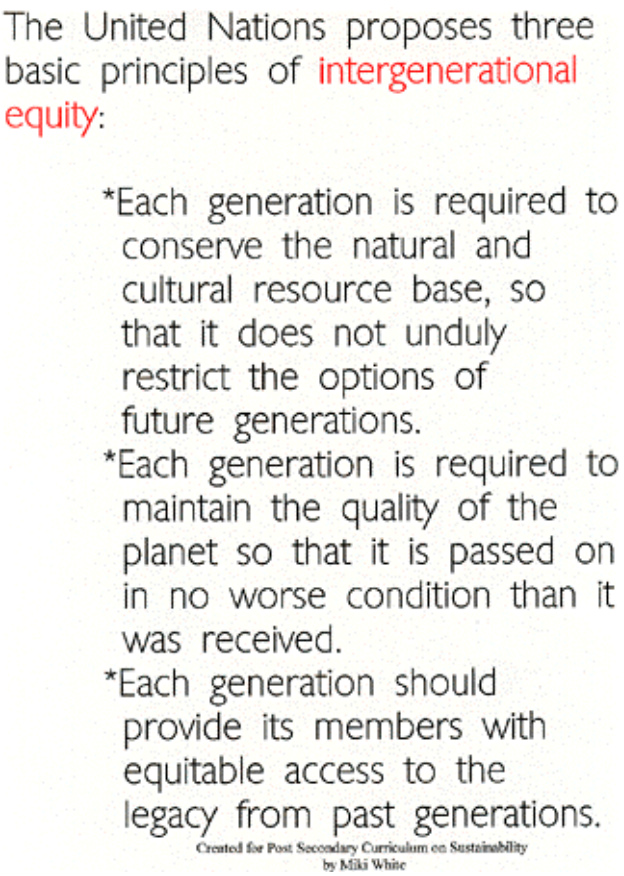
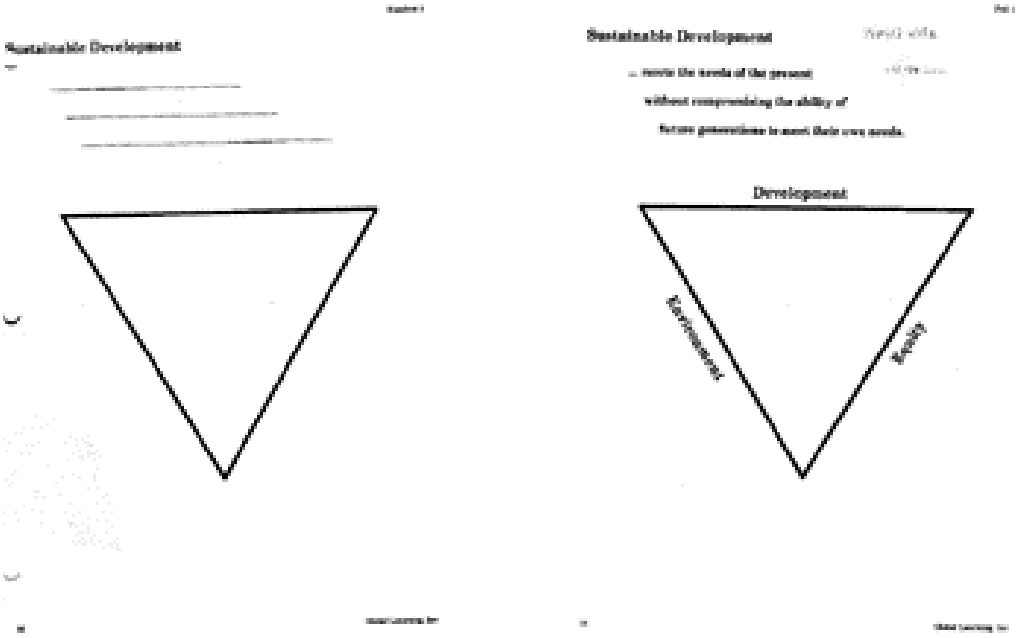


Figure 44: Intergenerational Equity

5) Pass out the handout Sustainable Development. Use transparencies 56 and 57. Discuss the meanings of the three words; development, environment, and equity. Note that our desire to create a sustainable planet involves the interconnectedness of these three things and within each all other aspects can be discussed.



Figures 45 and 46: Sustainable Development

From Global Learning Inc.

-What aspects are involved within development? Environment? Equity?

-What is involved within each as far as rights?

-What duties do we have to ensure sustainable development, a sustainable environment, and equity?

As the students answer these questions place the transparency on the overhead with the subtopics within each.

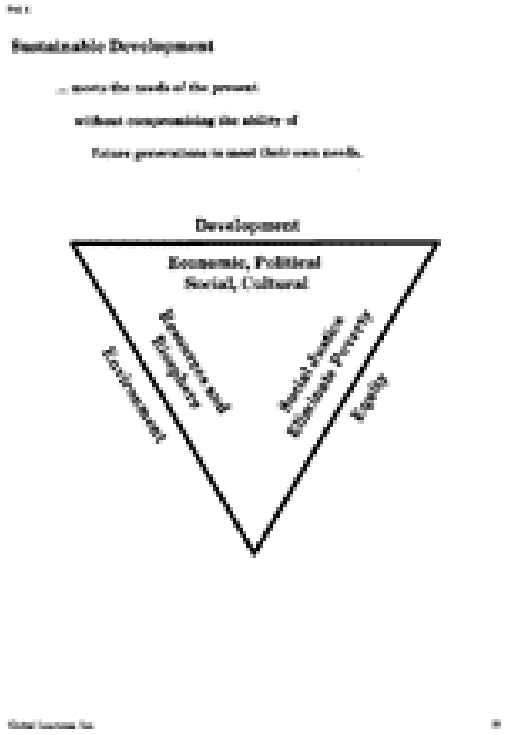


Figure 47: Sustainable Development

From Global Learning Inc.

-Discuss the interrelatedness of these issues.

-Do we have responsibilities to future generations?

*Justice between generations involves not only duties, but also rights, not only between generations, but also between members of the same generation.

6) Relate Rights *to Our Ecological Footprint*.

Key Statements for Discussion:

Location	Statement
Page 32	some consume the Earth's resources at a rate that would leave little for future generations. Others, many more in number, consume far too little and live with the prospects of hunger, squalor, disease, and early death. . . . For the first time, environment and equity became explicit factors in the development equation.
Page 38	Respect for, and the preservation of, other species and ecosystems for their intrinsic and spiritual values would automatically ensure human ecological security.
Page 57	Do we have an inherent right to so much of nature's productivity at the expense of the several million other species living on the planet?
Page 73	. . . equity between generation is a precondition for sustainability.

7) Relate Rights to The Ecology of Commerce.

Key Statements for Discussion:

Location	Statement
Page 5	But now, rather than disturbing the wealth of the present, we are stealing the wealth of the future to enrich a society that seems nonetheless deeply troubled about its "good fortune.
Page 8	Tinkering with the system will not bring species back to life, profit-sharing schemes do not restore our wetlands, donating money for a new production of *Don Giovanni* will not purify our water, nor will printing annual reports on recycled paper save us.

8) Relate Rights to *Environmental Ethics*.

Key Statements for Discussion.

Location	Statement
Page 144	A duty to a species is more like being responsible to a cause than to a person.
Page 146	. . . duties cannot be to species but must be to future humans, who will have beliefs, desires, and so on.
Page 153	Particular species may not be essential- - in the sense that the ecosystem can survive the

loss of individual species without adverse effect- - but habitats are essential to species, and an endangered species typically means an endangered habitat.

Assignment:

Project:

Video Projects are due next week at the beginning of class.

Reading:

Finish *Environmental Ethics Duties to and Values in The Natural World* by Holmes Rolston, III

Week Fourteen

WHERE DO WE GO FROM HERE?

Thought for the Day (Amazing Eco-Facts and Figures):

The energy generated from one recycled six-pack of aluminum cans will operate a television set for 18 hours.

Purpose:

To show how one person can make a difference towards a sustainable planet.

Objectives:

1) To explain how small steps count.
2) To explain how and why change takes time.
3) To give examples of frameworks to use to become more sustainable.

Background Information:

To answer the question "Where do we go from here?" one must have an idea of what needs to be done to create a sustainable planet. As gathered from the *Science* portion of this course; everything is involved in cycles, we need to use less nonrenewable resources, we need to control populations, and we need to live within if not under the means of nature. The *Economics* portion taught us that land use issues are more economic than environmental, that our consumerism is increasing per capita, and that our footprint is measured by the "true cost" of materials. The *Philosophy* portion discussed our morals and how we should be ethical in creating equity throughout the world and in doing so does not necessarily reduce our quality of life. Now that we know these things we can produce our own or model a framework already developed to live by.

The ever so popular Reduce, Recycle, Reuse phrase is a good simple framework, yet it is not all encompassing. It does not have any mention of one of the most important components, equity. A more thorough framework is that of the Natural Step. They have four principles they believe we should live by. These principles are:

1) Reduce what we take from the earth's crust.
2) Reduce what we make from all materials, natural and synthetic.
3) Maintain the current quality of the natural environment.
4) Distribute resources fairly.

In short, reduce what we take and make, maintain quality, and be fair.

TAKE

MAKE

MAINTAIN

BE FAIR

This is only one example of a framework to follow that will help you to help the world become more sustainable.

It is important to mention that no matter what principles are established they need to be followed, but slow change is good. Start with small steps. No one can become sustainable overnight.

Materials:

Transparencies:

Thought for the Day

Sustainability requires . . . (F-48)

The Natural Step Four Principles (F-49)

Small Steps Count (F-50)

TV/VCR

Procedure:

1) Begin by discussing what needs to be done in order for the earth to become sustainable.

   -What did we learn in the *Science* portion of this course?

   -What did we learn in the *Economics* portion of this course?

   -What did we learn in the *Philosophy* portion of this course?

   -What do we need to do to reduce our impacts on the Earth?

2) Place the transparency ***Sustainability requires . . .*** , F-48 on the overhead and read aloud.

Figure 48: Sustainability requires . . .

-What does this mean?

-How do we manage ourselves?

The student should get from this that we need some sort of guidelines to follow.

3) Discuss what type of guidelines we should have. Take a class poll of the principles (guidelines) the class believes are most important.

-Is the phrase Reduce, Recycle, Reuse enough to become sustainable?

-How many principles would be needed to create a sustainable planet?

-Can a sustainable planet be established with only four principles?

4) Place the transparency of ***The Natural Step Four Principles***, F-49 on the overhead.

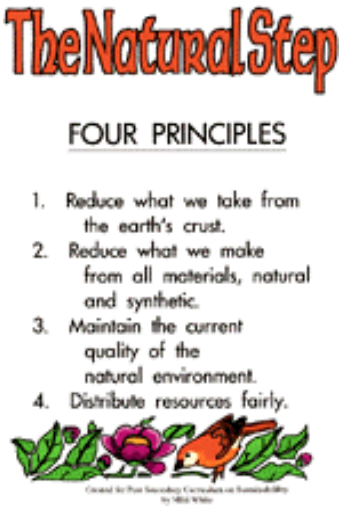


Figure 49: The Natural Step Four Principles

Discuss.

-Are these principles all encompassing?

-Do you feel they are realistic?

-If you do not agree, what would your principles be?

5) Discuss that no matter what your principles are, small steps count.

Place the transparency ***Small Steps Count***, F-50 on the overhead and read aloud.

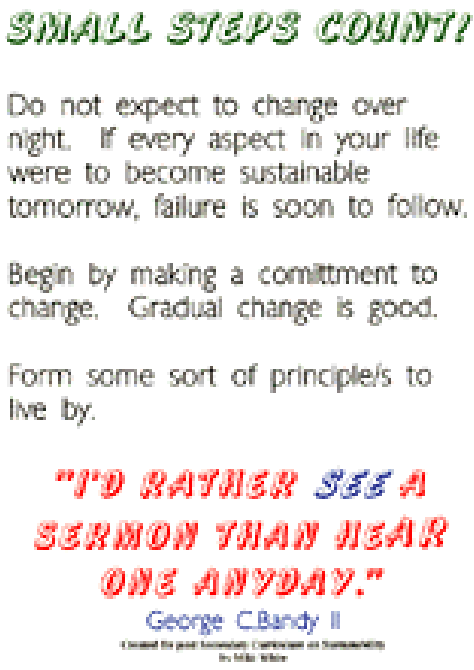


Figure 50: Small Step Count

6) Values Post Test (pages 166-167)

7) Watch everyone's video project.

Assignment:

Study: Prepare for Exam 3. Refer to the syllabus for format.

Name _____ Instructor _____ Section _____

SUSTAINABILITY: VALUES POST-TEST

Answer the following questions based on your first reaction after reading the statement.

1 = strongly agree 2 = agree 3 = neutral 4 = disagree 5 = strongly disagree

1) I worry about environmental problems.

1 2 3 4 5

2) It makes me happy to see people trying to save energy.

1 2 3 4 5

3) I am frightened about the effects of pollution on my family.

1 2 3 4 5

4) I get upset when I think of the things people throw away that could be recycled.

1 2 3 4 5

5) I would be willing to ride the bus to more places in order to reduce air pollution.

1 2 3 4 5

6) It makes me sad to see houses being built where animals used to live.

1 2 3 4 5

10) I Have asked others what I can do to reduce pollution.

1 2 3 4 5

11) I would be willing to write letters asking people to reduce pollution.

1 2 3 4 5

12) I would be willing to save energy by using less air conditioning.

1 2 3 4 5

10) I feel the population growth rate is a problem.

1 2 3 4 5

11) I would give $15 of my own money to help protect an animal.

1 2 3 4 5

12) I buy recycled products whenever possible.

1 2 3 4 5

13) I would be willing to pay more for recycled products.

1 2 3 4 5

14) I turn off lights when they are not in use.

1 2 3 4 5

15) I have talked friends into recycling.

1 2 3 4 5

16) I would be willing to stop buying products to protect the environment.

1 2 3 4 5

17) I would be willing to go from house to house to ask people to recycle.

1 2 3 4 5

18) I enjoy reading stories about the environment.

1 2 3 4 5

19) I am concerned about the population growth rate in other countries.

1 2 3 4 5

20) I feel that I live in total alignment with my values and beliefs.

1 2 3 4 5

Week Fifteen

EXAM 3/FINAL

Thought for the day (Amazing Eco-Facts and Figures):

It takes one person to change the world.

Materials: Transparency (optional, not numbered)

Exam:

The final exam is made up of 100 multiple choice questions. It is recommended to be taken on scan-tron for fast, easy grading at the end of the semester.

Answer Key:

1) D	21) D	41) B	61) A	81) D
2) A	22) C	42) C	62) D	82) A
3) B	23) B	43) C	63) D	83) D
4) D	24) A	44) B	64) D	84) A
5) C	25) B	45) C	65) D	85) D
6) B	26) C	46) B	66) C	86) B
7) B	27) D	47) D	67) C	87) D
8) D	28) C	48) A	68) B	88) C
9) A	29) B	49) A	69) A	89) B
10) B	30) C	50) C	70) B	90) A
11) C	31) D	51) B	71) C	91) A
12) C	32) C	52) C	72) C	92) B
13) D	33) D	53) C	73) A	93) C
14) B	34) A	54) B	74) B	94) B
15) C	35) B	55) D	75) C	95) D
16) D	36) A	56) B	76) A	96) C
17) B	37) A	57) D	77) D	97) B
18) C	38) C	58) D	78) B	98) D
19) B	39) C	59) D	79) A	99) C
20) A	40) D	60) A	80) C	100) D

Name _____ Instructor _____ Section _____

SUSTAINABILITY: EXAM 3/FINAL

MULTIPLE CHOICE: Chose the appropriate letter that best answers the question.

1) Basic needs for all individuals to survive are all of the following except

   a) food

   b) shelter

   c) sense of well-being

   d) air conditioning

2) P.Q.L. stand for

   a) physical quality of life

   b) place of quality living

   c) please quantify living

   d) place qualified as livable

3) An ethic is defined as

   a) what is right or wrong based on a culture

   b) what is fundamentally right or wrong

   c) what one places value on

   d) what is desirable

4) A human centered theory that believes all environmental responsibility is derived from human interests is

   a) biocentric

   b) ecocentric

   c) ethocentric

   d) anthropocentric

5) An ecocentric believes

   a) that environmental responsibility is derived from human interests.

   b) all forms of life have an inherent right to exist.

   c) that the environment deserves direct moral consideration.

   d) cultural values take precedent over the environment.

6) A life-centered theory in which all forms of life have an inherent right to exist is

   a) anthropocentric

   b) biocentric

   c) ethocentric

   d) ecocentric

7) Creating continual change is the

   a) preservation ethic

   b) development ethic

   c) conservation ethic

   d) economic ethic

8) A person with a development ethic would be considered a/an

a) biocentric

b) ecocentric

c) ethocentric

d) anthropocentric

9) The _____ ethic stresses a balance between total development and absolute preservation.

a) conservation

b) recycle

c) protection

d) environmental

10) _____ take into consideration cultural values.

a) ethics

b) morals

c) rights

d) laws

11) The difference between ethics and morals is that

a) ethics reflect values.

b) ethics reflect laws.

c) morals reflect cultural values.

d) morals reflect rights.

12) The country that has the lowest P.Q.L from our study in class is

a) India

b) Cuba

c) Ethiopia

d) Mexico

13) The country that has the highest P.Q.L. from our study in class is

a) Egypt

b) United States

c) Japan

d) France

14) P.Q.L. is based on all of the following social indicators except

a) infant mortality

b) GNP

c) life expectancy

d) literacy rate

15) The country with the highest adolescent pregnancy rate and abortion rate is

a) China

b) France

c) United States

d) Mexico

16) A moral or legal obligation is a

a) right

b) requirement

c) standard

d) duty

17) Einstein defined the environment as

a) “all things around me”

b) “everything that isn’t me”

c) “the universe and beyond”

d) “everything from the biggest big to the smallest small”

18) Environmental rights involve

a) land, air, and water

b) land, water, and humans

c) land, air, water, other species, and humans

d) land and other species

1) Each generation should provide its members with equitable access to the legacy from past generations is a principle of intergenerational equity proposed by the

a) British White Papers

b) United Nations

c) Secretary of State

d) United States

20) A society's process of improving the quality of human lives including; income and consumption levels; social, political and economic institutions; and freedom of choice over decisions is defined as

a) development

b) growth

c) technology

d) improvement

21) The three disciplines that encompass all areas of sustainability are

a) math, literature, and philosophy

b) philosophy, religion, and economics

c) government, economics, and literature

d) science, economics, and philosophy

22) The Natural Step has ____ principles to live by to create a sustainable planet.

a) 2

b) 3

c) 4

d) 5

23) According to Mathis Wackernagel, “Sustainability requires that our emphasis shift from managing _____ to managing _____, that we learn to live as part of nature.”

a) resources, others

b) resources, ourselves

c) ourselves, resources

d) others, ourselves

24) The first principle from The Natural Step is to

a) reduce what we take

b) distribute resources fairly

c) maintain the current quality of the planet

d) recycle

25) One billion people around the globe are surviving on less than _____ each year.

a) $ 100

b) $ 400

c) $ 800

d) $ 1000

26) The Physical Quality of Life Index was developed by the

a) United Nations

b) Secretary of State

c) Overseas Development Council

d) United States

27) Every week, about _____ plant and animal species become extinct.

a) 5

b) 10

c) 15

d) 20

28) Pushing "moral superiority" (playing off people's moral duty and feelings of guilt) will not make sustainability happen is a belief of

a) Paul Hawken

b) Holmes Rolston, III

c) Mathis Wackernagel and William Rees

d) Einstein

29) For there to be equity among humans there must be all of the following except

a) elimination of poverty

b) elimination of taxes

c) elimination of hunger

d) elimination of suffering

30) The United Nation's Intergenerational Equity principles include all of the following except

a) Each generation is required to conserve the natural and cultural resource base.

b) Each generation is required to maintain the quality of the planet.

e) Each generation is required to replace more than they consume due to increasing population.

d) Each generation should provide its members with equitable access to the legacy from past generations.

31) The relationship between economic development and quality of life is

a) more developed, higher quality of life

b) less developed, higher quality of life

c) more developed, equal quality of life

d) no relationship

32) Bigger, better, faster is the motto of a/an

a) conservation ethic

b) preservation ethic

c) development ethic

d) ecocentric ethic

33) Differences between ethics and morals can be based on

a) religion

b) culture

c) society

d) all of the above

34) Unplanned growth in suburban areas is called

a) urban sprawl

b) urban webbing

c) suburban webbing

d) economic sprawl

35) A thin covering of _____ consists of a mixture of water, living organisms, minerals, organic material, and air that supports all plant life.

a) rocks

b) soil

c) bedrock

d) grass

36) Currently in the U. S. about _____ of land is used intensively by people in urban centers and as transportation corridors.

a) 5%

b) 23%

c) 50%

d) 75%

37) Each American produces about ____ pound of garbage each _____.

a) 4, day

b) 12, month

c) 20, month

d) 10, day

38) Americans make up 1/20 of the world's population, but use _____ of the world's energy.

a) 1/2

b) 2/3

c) 1/4

d) 1/5

39) Planning which considers all aspects including geologic, ecologic, economic, health, and social factors is called

a) regulation

b) zoning

c) ecological land-use planning

d) land-use planning

40) The wise use of the Earth's natural resources was defined by Pinchot to be _____.

a) reclamation

b) preservation

c) environmentally friendly

d) conservation

41) Regulation that allows more than one use of the land at the same time is called

a) ecological land-use

b) multiple land-use

c) multiple regulation of land

d) ecological regulation

42) The Reclamation Act was established in what decade?

a) 1920-1929

b) 1910-1919

c) 1900-1909

d) 1890-1899

43) The Decade of environmental command and control by the government was the ___.

a) 1990's

b) 1980's

c) 1970's

d) 1960's

44) All of the following are renewable resources except _____.

a) wind

b) nuclear

c) geothermal

d) biomass

45) Currently in the United States about _____ of land is used for crops and livestock.

a) 83%

b) 65%

c) 47%

d) 33%

46) Gifford Pinchot was named Chief Forester by

a) President Truman

b) President Theodore Roosevelt

c) President Kennedy

d) Secretary of State Baker

47) The maximum number of inhabitants that an environment can support without detrimental effects is its

a) load

b) biological capacity

c) biological number

d) carrying capacity

48) Development that meets the needs of the present without compromising the ability of future generations to meet their own needs, is the definition of sustainability given by

a) The Bruntland Commission

b) British Government

c) Gifford Pinchot

d) The EPA

49) The three fossil fuels formed from the remains of tiny sea creatures are

a) propane, natural gas, and petroleum

b) coal, propane, and petroleum

c) natural gas, coal, and petroleum

d) propane, coal, and natural gas

50) The slowest cyclical process on earth is the

a) nitrogen cycle

b) oxygen cycle

c) rock cycle

d) carbon cycle

51) The well known environmental literature written by Aldo Leopold was titled

a) *Ecological Footprint*

b) *Land Ethic*

c) *Silent Spring*

d) *Should Trees Have Standing*

52) Two U.S. children have as much impact on earth as _____ children in an LDC.

a) 25-50

b) 50-100

c) 100-200

d) 200-300

53) The National Park System was established in

a) 1963

b) 1930

c) 1912

d) 1900

54) One of the major contributions to a country's increased energy use is

a) level of education

b) affluence

c) population

d) knowledge of environmental concerns

55) Earth's capital includes all of the following except

a) air

b) wildlife

c) water

d) buildings

56) The way to measure consumption derived by Mathis Wackernagel and William Rees is our

a) ecological impact

b) ecological footprint

c) ecological output

d) ecological situation

57) Exponential growth over time is characteristic of

a) resource consumption

b) population growth

c) pollution and environmental degradation

d) all of the above

58) The amount of ecologically productive land available per person on Earth is our

a) fair share

b) fair proportion

c) respectable piece

d) fair Earthshare

59) The conversion of solar energy into chemical energy occurs in

a) carbon cycle

b) decomposition

c) food chain

d) photosynthesis

60) Once of land has been used for one purpose it

a) is almost impossible to use it for anything else

b) must remain barren for 20 years

c) can never be used for any other purpose

d) must become a parking lot

61) All of the following increase the amount of carbon dioxide in the air except

a) photosynthesis

b) volcanic eruptions

c) combustion

c) respiration

62) Most of the national forests are located where?

a) central United States

b) western United States

c) southeastern United States

d) northeastern United States

63) The hydrologic cycle refers to the movement of

a) hydrogen

b) hydrocarbon

c) oxygen

d) water

64) In the rock cycle igneous rocks

a) come to the surface to go through weathering and erosion

b) sink down deep within the earth to become metamorphic rocks

c) melt again and become different igneous rock

d) all of the above

65) Two ways in which humans have most interfered with the carbon cycle are

a) burning of fossil fuels and causing volcanic eruptions

b) aerobic respiration and burning of fossil fuels

c) aerobic respiration and removal of forest

d) burning of fossil fuels and removal of forest

66) Land should be considered a

a) renewable resource

b) resuable resource

c) nonrenewable resource

d) nonreusable resource

67) An exponential curve is also known as a/an _____ curve.

a) S

b) L

c) J

d) U

68) Population dynamics include all of the following except

a) size

b) economic status

c) density

d) dispersion

69) The Multiple Use Sustained Yield Act of 1960

a) promoted multiple land-use zoning

b) required specific zoning of land

c) required agricultural land areas

e) promoted urban zoning

70) Density-independent population factors include all of the following except

a) drought

b) resource competition

c) fire

d) temperature changes

71) According to Our Ecological Footprint, humanity's ecological footprint is as much as _____ larger than nature can sustain in the long run.

a) 70%

b) 50%

c) 30%

d) 10%

72) All of the following elements are major components of living organisms except

a) nitrogen

b) carbon

c) calcium

d) oxygen

73) High-input production agriculture typically depletes cropland soils in North America _____ times faster than they can regenerate.

a) 10 to 20

b) 20 to 30

c) 30 to 40

d) 40 to 50

74) Energy

a) is concentrated by living organisms

b) flows in only one direction

c) originates at the center of the earth

d) recycles through the ecosystem

75) If everyone in the U.S. recycled their newspapers, we would save

a) 20,000 trees every week

b) 100,000 trees every week

c) 500,000 trees every week

d) 1,000,000 trees every week

76) The type of coal that contains the most carbon and is most efficient is

a) anthracite

b) bituminous

c) lignite

d) peat

77) In calculating an ecological footprint, monitoring is broken up into _____ consumption categories.

a) 10

b) 3

c) 7

d) 5

78) The oldest source of energy *collected* to release energy is

a) hydropower

b) biomass

c) wind

d) geothermal

79) All of the following are consumption categories for an ecological footprint calculation except

a) donations

b) services

c) transportation

d) food

80) The renewable energy source known as the most environmentally friendly is

a) geothermal energy

b) nuclear energy

c) solar energy

d) hydropower

81) The ecological footprint can be used to measure impact by

a) individuals

b) communities

c) countries

d) all of the above

82) Homes that have no special equipment, yet are built to be a solar collector are called

a) passive solar homes

b) active solar homes

c) inactive solar homes

d) energy conservers

83) The footprint of the United States is most similar to that of

a) Australia

b) India

c) China

d) Canada

84) Density-dependent population factors include all of the following except

a) natural disasters

b) predation

c) disease

d) competition of resources

85) A group of individuals of the same species occupying a given area is called a

a) genus

b) niche

c) community

d) population

86) The recommended length of tracking for a true measure of an ecological footprint is

a) five years

b) a year

c) a month

d) a week

87) Unplanned urban sprawl causes

a) transportation problems

b) loss of farmland

c) floodplain problems

d) all of the above

88) All of the following represent a *cycle* except

a) photosynthesis

b) hydrologic

c) energy

d) food chain

89) All of the following are true of humus soil except

a) it supplies nutrients needed by plants

b) organisms cannot live there due to acidity levels

c) it increases acidity levels needed for breakdown

d) it is porous, increasing water-holding capacity for plant growth

90) In the class demonstration for available land, the first cut was to divide the apple in fourths, 3/4 represented _____ and 1/4 represented _____.

a) oceans, land

b) icecaps, land

c) land, oceans

d) land, icecaps

91) Multiple land-use zoning requires at least _____ uses of the designated land.

a) 2

b) 3

c) 4

d) 5

92) The most widely used wind machine use today is the

a) vertical wind machine

b) horizontal wind machine

c) circular wind machine

d) all are used equally

93) Organisms cannot use _____ in the air directly.

a) carbon

b) water

c) nitrogen

d) oxygen

94) Maintaining a constant internal environment is called

a) photosynthesis

b) homeostasis

c) humus

d) respiration

95) Zoning protects _____ land.

a) agricultural

b) forested

c) developed

d) all types of

96) The three viewpoints of environmental responsibility are all of the following except

a) anthropocentric

b) biocentric

c) ethocentric

d) ecocentric

97) The widely accepted definition of sustainability is from the

a) British White Papers

b) The Brundtland Commission

c) University of Washington

d) Virginia Polytechnic Institute

98) The period of renewed interest in the environment is/was

a) 1960's

b) 1970's

c) 1980's

d) 1990's and beyond

99) All of the following are examples of rhythms of life or cycles in time except

a) lunar cycle

b) tidal changes

c) energy flow

d) day and night

100) The most important thing/s to take away from this course is/are

a) becoming sustainable has to start with the individual

b) you must have some sort of principles to live by

c) small steps count

d) all of the above

APPENDIX A

SUSTAINABILITY PRETEST

Name _____ Instructor _____ Section _____

SUSTAINABILITY: VALUES PRE-TEST

Answer the following questions based on your first reaction after reading the statement.

1 = strongly agree 2 = agree 3 = neutral 4 = disagree 5 = strongly disagree

1) I worry about environmental problems.

1 2 3 4 5

2) It makes me happy to see people trying to save energy.

1 2 3 4 5

3) I am frightened about the effects of pollution on my family.

1 2 3 4 5

4) I get upset when I think of the things people throw away that could be recycled.

1 2 3 4 5

5) I would be willing to ride the bus to more places in order to reduce air pollution.

1 2 3 4 5

6) It makes me sad to see houses being built where animals used to live.

1 2 3 4 5

7) I have asked others what I can do to reduce pollution.

1 2 3 4 5

8) I would be willing to write letters asking people to reduce pollution.

1 2 3 4 5

9) I would be willing to save energy by using less air conditioning.

1 2 3 4 5

10) I feel the population growth rate is a problem.

1 2 3 4 5

11) I would give $15 of my own money to help protect an animal.

1 2 3 4 5

12) I buy recycled products whenever possible.

1 2 3 4 5

13) I would be willing to pay more for recycled products.

1 2 3 4 5

14) I turn off lights when they are not in use.

1 2 3 4 5

15) I have talked friends into recycling.

1 2 3 4 5

16) I would be willing to stop buying products to protect the environment.

1 2 3 4 5

17) I would be willing to go from house to house to ask people to recycle.

1 2 3 4 5

18) I enjoy reading stories about the environment.

1 2 3 4 5

19) I am concerned about the population growth rate in other countries.

1 2 3 4 5

20) I feel that I live in total alignment with my values and beliefs.

1 2 3 4 5

For 21-40 chose the correct term/statement that answers the question.

21) Americans make up 1/20 of the world's population, but use _____ of the world's energy.

a) 1/2
b) 1/4
c) 1/5
d) 2/3

22) The wise use of the Earth's natural resources was defined by Pinchot to be

a) reclamation
b) preservation
c) environmentally friendly
d) conservation

23) Although 3/4 of the earth is covered by water, less than _____ is readily available for human use.

a) 3 %
b) 5 %
c) 1 %
d) 2 %

24) The Reclamation Act was established in what decade?

a) 1890-1899
b) 1900-1909
c) 1910-1919
d) 1920-1929

25) Each American produces about _____ pounds of garbage each _____.

a) 10, day
b) 20, month
c) 12, month
d) 4, day

26) The Decade of environmental command and control by the government was the _____.

a) 1960's
b) 1970's
c) 1980's
d) 1990's

27) Sustainability is *mostly* taught through what discipline?

a) Philosophy
b) Education
c) Economics
d) Engineering

28) _____ people around the world are surviving on less than $400 each year.

a) one million
b) ten million
c) one billion
d) two billion

29) All of the following are renewable resources *except* _____

a) wind
b) nuclear
c) geothermal
d) biomass

30) Each generation is required to maintain the quality of the planet so that it is passed on in no worse condition than it was received is a principle of

a) intergenerational equity
b) cultural equity
c) generation consumption
d) environmental rights

31) The principle mentioned in question 30 was proposed by the

a) EPA
b) Texas Energy Conservation Commission
c) President's Council
d) United Nations

32) The value statement “the love of money is the root of all evil” comes from:

a) an American businessman
b) the New Testament
c) an inscription on a fortune cookie
d) George Bernard Shaw

33) President John Kennedy in his Inaugural Address stated . . .

a) “Development is broadly culture dependent. Progress is based on what is considered important, and this depends on culture.”
b) “If a free society cannot help the many who are poor, it cannot save the few who are rich.”
c) “It is thrifty today to prepare for the wants of tomorrow.”
d) “If you give a man a fish, he will have a single meal. If you teach him how to fish, he will eat all his life.”

34) The maximum number of inhabitants that an environment can support without detrimental effects is its _____.

a) load
b) biological number
c) carrying capacity
d) biological capacity

35) The three fossil fuels formed from the remains of tiny sea creatures are

a) propane, coal, and natural gas
b) natural gas, coal, and petroleum
c) coal, natural gas, and petroleum
d) propane, natural gas, and petroleum

36) Development that meets the needs of the present without compromising the ability of future generations to meet their own need, is the definition of sustainability given by

a) The Bruntland Commission
b) British Government
c) Gifford Pinchot
d) The EPA

37) Gifford Pinchot was named Chief Forester by

a) President Kennedy
b) President Theodore Roosevelt
c) Secretary of State Baker
d) President Truman

38) The most well known environmental literature written by Aldo Leopold was titled

a) *Should Trees Have Standing*
b) *Silent Spring*
c) *Land Ethic*
d) *Ecological Footprint*

39) The National Park System was established in

a) 1900
b) 1912
c) 1930
d) 1963

40) If you lined up all the styrofoam cups made in just one day, they would

a) circle the earth and go a little further
b) build a wall 3 feet high from New York to Los Angeles
c) reach from the North Pole to the South Pole
d) outline Texas twice

For questions 41-50 circle T for True Statements and F for False Statements.

T F 41) Every week about 20 plant and animal species die.

T F 42) Environmental Impact Statements became required in the 70's.

T F 43) Over half of all the plant and animal species in the world, live in the tropical forest.

T F 44) Sustainability is taught most often through Engineering.

T F 45) The environmental "cost" is always given in a dollar figure.

T F 46) Intergeneration Equity is the responsibility of the present.

T F 47) Development can be defined by improving the quality of life.

T F 48) An ethical person always “values” the environment.

T F 49) The Satisfaction Barometer measures material gains.

T F 50) Nuclear Energy is non-renewable.

APPENDIX B

SUSTAINABILITY POST TEST

Name _____ Instructor _____ Section _____

SUSTAINABILITY: VALUES POST-TEST

Answer the following questions based on your first reaction after reading the statement.

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1) I worry about environmental problems.

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3) I am frightened about the effects of pollution on my family.

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16) I would be willing to stop buying products to protect the environment.

1 2 3 4 5

17) I would be willing to go from house to house to ask people to recycle.

1 2 3 4 5

18) I enjoy reading stories about the environment.

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19) I am concerned about the population growth rate in other countries.

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T F 50) Nuclear Energy is non-renewable.

APENDIX C

SUSTAINABILITY PRE AND POST TEST ANSWER KEY

SUSTAINABILITY

ANSWER KEY FOR QUESTIONS 21-50

21) b
22) d
23) c
24) b
25) d
26) b
27) a
28) c
29) b
30) a
31) d
32) b
33) b
34) c
35) d
36) a
37) b
38) c
39) b
40) a
41) T
42) T
43) T
44) F (Philosophy)
45) F (it can be given in a dollar figure, but not ALWAYS)
46) T
47) T
48) F (ethical means knowing right from wrong, placing value gives worth)
49) F (satisfaction is measured subjectively, material gains are objective measures)
50) T

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